

SPECIAL MAINTENANCE ISSUE

McGraw-Hill Publishing Company, Inc.

JULY, 1939

Price 35c. per copy

AVIATION

The Oldest American Aeronautical Magazine

GRUMMANS *for the Coast Guard*



This month finds a new group of Grumman G-21A's joining the United States Coast Guard. Swift and sturdy, they are built to carry out their assignments under any conditions—fair weather or foul. And their dependable Pratt & Whitney engines are true to the famous Coast Guard motto "Semper Paratus"—Always Ready.

PRATT & WHITNEY AIRCRAFT

One of the three divisions of

UNITED AIRCRAFT CORPORATION, EAST HARTFORD, CONNECTICUT





NEW AS TOMORROW, YET— A VETERAN IN SERVICE

The basic design of the 1939-40 Howard remains as new as tomorrow, yet its like has been proven in millions of miles of flight.

Conceded by the majority to offer the best combination of speed, load-carrying ability and flying characteristics, this new model has excellent vision, interior spaciousness for five, and a landing ability not excelled by much slower makes.

Ask for the new Brochure named the HOWARD AIRCRAFTER just off the press. Read about the top 4-5 place airplane of the year.



1938

Continental
Engine



1937

Continental
Engine



1935

Continental
Engine



1936

Continental
Engine



For people who like lots of room—effortless room, spacious, load-carrying and baggage room—the new Piper Cub Coupe is the place! There's a ship that does not leave you to a lost friend and make you feel like a soldier.

Although the Cub Coupe is so convenient to buy and fly, takes off and lands in small fields, "movers and" in a class and maintains high speed, it is a complete, luxurious, roomy, side-by-side plane—with all the "extras" as no extra cost—and with plenty of baggage space. It has a baggage compartment that is 28" x 40" x 12" and has 165 pounds

baggage capacity. Approved by CAA for a total gross load of 1301 pounds, bringing it into the 2-5 class. You have a choice of 60 or 50 h.p. engines. A complete plane modestly priced from \$1960—as little as \$485 down.

ONLY \$485 DOWN

gives you a new \$1040 Piper Cub 40 h.p. Trainer on the pay-as-you-fly plan. Other models include 50 h.p. Trainer from \$1290, 50 h.p. Sports from \$1340, and Bonapartes from \$1790. All prices F.A.S. Lock Haven, Pa., and subject to increase without notice.

Free Flying Course

The Howard Cub Coupe from whom you may now own Piper Cub will arrange for you to receive a course of flight flying instruction in your own area. Please fill a questionnaire (attached) and send it to the nearest office.

Free Catalog

Read what the Cub really does! Get the free flying course and more of your Cub. Write: Piper Aircraft Corporation, 701 S. Third, Lock Haven, Pa. 17045. Cub Coupe! Or, Ltd., Corporation, Elmwood.

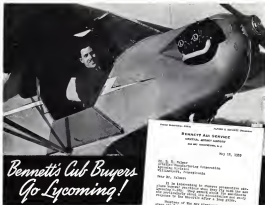
Visit Us at the New York and San Francisco Fairs and at the Cub Factory



COUNT THE CUBS

THE WORLD'S FASTEST
FREEING AIRPLANE

Published monthly since 1934, a new, outstanding new-Cublet, Hawk, Hawk, and Hawk! America's fastest, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 2681, 2682, 2683, 2684, 2685, 2686, 2687, 2688, 2689, 2690, 2691, 2692, 2693, 2694, 2695, 2696, 2697, 2698, 2699, 2700, 2701, 2702, 2703, 2704, 2705, 2706, 2707, 2708, 2709, 2710, 2711, 2712, 2713, 2714, 2715, 2716, 2717, 2718, 2719, 2720, 2721, 2722, 2723, 2724, 2725, 2726, 2727, 2728, 2729, 2730, 2731, 2732, 2733, 2734, 2735, 2736, 2737, 2738, 2739, 2740, 2741, 2742, 2743, 2744, 2745, 2746, 2747, 2748, 2749, 2750, 2751, 2752, 2753, 2754, 2755, 2756, 2757, 2758, 2759, 2760, 2761, 2762, 2763, 2764, 2765, 2766, 2767, 2768, 2769, 2770, 2771, 2772, 2773, 2774, 2775, 2776, 2777, 2778, 2779, 2780, 2781, 2782, 2783, 2784, 2785, 2786, 2787, 2788, 2789, 2790, 2791, 2792, 2793, 2794, 2795, 2796, 2797, 2798, 2799, 2800, 2801, 2802, 2803, 2804, 2805, 2806, 2807, 2808, 2809, 2810, 2811, 2812, 2813, 2814, 2815, 2816, 2817, 2818, 2819, 2820, 2821, 2822, 2823, 2824, 2825, 2826, 2827, 2828, 2829, 2830, 2831, 2832, 2833, 2834, 2835, 2836, 2837, 2838, 2839, 2840, 2841, 2842, 2843, 2844, 2845, 2846, 2847, 2848, 2849, 2850, 2851, 2852, 2853, 2854, 2855, 2856, 2857, 2858, 2859, 2860, 2861, 2862, 2863, 2864, 2865, 2866, 2867, 2868, 2869, 2870, 2871, 2872, 2873, 2874, 2875, 2876, 2877, 2878, 2879, 2880, 2881, 2882, 2883, 2884, 2885, 2886, 2887, 2888, 2889, 2890, 2891, 2892, 2893, 2894, 2895, 2896, 2897, 2898, 2899, 2900, 2901, 2902, 2903, 2904, 2905, 2906, 2907, 2908, 2909, 2910, 2911, 2912, 2913, 2914, 2915, 2916, 2917, 2918, 2919, 2920, 2921, 2922, 2923, 2924, 2925, 2926, 2927, 2928, 2929, 2930, 2931, 2932, 2933, 2934, 2935, 2936, 2937, 2938, 2939, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 2948, 2949, 2950, 2951, 2952, 2953, 2954, 2955, 2956, 2957, 2958, 2959, 2960, 2961, 2962, 2963, 2964, 2965, 2966, 2967, 2968, 2969, 2970, 2971, 2972, 2973, 2974, 2975, 2976, 2977, 2978, 2979, 2980, 2981, 2982, 2983, 2984, 2985, 2986, 2987, 2988, 2989, 2990, 2991, 2992, 2993, 2994, 2995, 2996, 2997, 2998, 2999, 3000, 3001, 3002, 3003, 3004, 3005, 3006, 3007, 3008, 3009, 3010, 3011, 3012, 3013, 3014, 3015, 3016, 3017, 3018, 3019, 3020, 3021, 3022, 3023, 3024, 3025, 3026, 3027, 3028, 3029, 3030, 3031, 3032, 3033, 3034, 3035, 3036, 3037, 3038, 3039, 3040, 3041, 3042, 3043, 3044, 3045, 3046, 3047, 3048, 3049, 3050, 3051, 3052, 3053, 3054, 3055, 3056, 3057, 3058, 3059, 3060, 3061, 3062, 3063, 3064, 3065, 3066, 3067, 3068, 3069, 3070, 3071, 3072, 3073, 3074, 3075, 3076, 3077, 3078, 3079, 3080, 3081, 3082, 3083, 3084, 3085, 3086, 3087, 3088, 3089, 3090, 3091, 3092, 3093, 3094, 3095, 3096, 3097, 3098, 3099, 3100, 3101, 3102, 3103, 3104, 3105, 3106, 3107, 3108, 3109, 3110, 3111, 3112, 3113, 3114, 3115, 3116, 3117, 3118, 3119, 3120, 3121, 3122, 3123, 3124, 3125, 3126, 3127, 3128, 3129, 3130, 3131, 3132, 3133, 3134, 3135, 3136, 3137, 3138, 3139, 3140, 3141, 3142, 3143, 3144, 3145, 3146, 3147, 3148, 3149, 3150, 3151, 3152, 3153, 3154, 3155, 3156, 3157, 3158, 3159, 3160, 3161, 3162, 3163, 3164, 3165, 3166, 3167, 3168, 3169, 3170, 3171, 3172, 3173, 3174, 3175, 3176, 3177, 3178, 3179, 3180, 3181, 3182, 3183, 3184, 3185, 3186, 3187, 3188, 3189, 3190, 3191, 3192, 3193, 3194, 3195, 3196, 3197, 3198, 3199, 3200, 3201, 3202, 3203, 3204, 3205, 3206, 3207, 3208, 3209, 3210, 3211, 3212, 3213, 3214, 3215, 3216, 3217, 3218, 3219, 3220, 3221, 3222, 3223, 3224, 3225, 3226, 3227, 3228, 3229, 3230, 3231, 3232, 3233, 3234, 3235, 3236, 3237, 3238, 3239, 3240, 3241, 3242, 3243, 3244, 3245, 3246, 3247, 3248, 3249, 3250, 3251, 3252, 3253, 3254, 3255, 3256, 3257, 3258, 3259, 3260, 3261, 3262, 3263, 3264, 3265, 3266, 3267, 3268, 3269, 3270, 3271, 3272, 3273, 3274, 3275, 3276, 3277, 3278, 3279, 3280, 3281, 3282, 3283, 3284, 3285, 3286, 3287, 3288, 3289, 3290, 3291, 3292, 3293, 3294, 3295, 3296, 3297, 3298, 3299, 3300, 3301, 3302, 3303, 3304, 3305, 3306, 3307, 3308, 3309, 3310, 3311, 3312, 3313, 3314, 3315, 3316, 3317, 3318, 3319, 3320, 3321, 3322, 3323, 3324, 3325, 3326, 3327, 3328, 3329, 3330, 3331, 3332, 3333, 3334, 3335, 3336, 3337, 3338, 3339, 3340, 3341, 3342, 3343, 3344, 3345, 3346, 3347, 3348, 3349, 3350, 3351, 3352, 3353, 3354, 3355, 3356, 3357, 3358, 3359, 3360, 3361, 3362, 3363, 3364, 3365, 3366, 3367, 3368, 3369, 3370, 3371, 3372, 3373, 3374, 3375, 3376, 3377, 3378, 3379, 3380, 3381, 3382, 3383, 3384, 3385, 3386, 3387, 3388, 3389, 3390, 3391, 3392, 3393, 3394, 3395, 3396, 3397, 3398, 3399, 3400, 3401, 3402, 3403, 3404, 3405, 3406, 3407, 3408, 3409, 3410, 3411, 3412, 3413, 3414, 3415, 3416, 3417, 3418, 3419, 3420, 3421, 3422, 3423, 3424, 3425, 3426, 3427, 3428, 3429, 3430, 3431, 3432, 3433, 3434, 3435, 3436, 3437, 3438, 3439, 3440, 3441, 3442, 3443, 3444, 3445, 3446, 3447, 3448, 3449, 3450, 3451, 3452, 3453, 3454, 3455, 3456, 3457, 3458, 3459, 3460, 3461, 3462, 3463, 3464, 3465, 3466, 3467, 3468, 3469, 3470, 3471, 3472, 3473, 3474, 3475, 3476, 3477, 3478, 3479, 3480, 3481, 3482, 3483, 3484, 3485, 3486, 3487, 3488, 3489, 3490, 3491, 3492, 3493, 3494, 3495, 3496, 3497, 3498, 3499, 3500, 3501, 3502, 3503, 3504, 3505, 3506, 3507, 3508, 3509, 3510, 3511, 3512, 3513, 3514, 3515, 3516, 3517, 3518, 3519, 3520, 3521, 3522, 3523, 3524, 3525, 3526, 3527, 3528, 3529, 3530, 3531, 3532, 3533, 3534, 3535, 3536, 3537, 3538, 3539, 3540, 3541, 3542, 3543, 3544, 3545, 3546, 3547, 3548, 3549, 3550, 3551, 3552, 3553, 3554, 3555, 3556, 3557, 3558, 3559, 3560, 3561, 3562, 3563, 3564, 3565, 3566, 3567, 3568, 3569, 3570, 3571, 3572, 3573, 3574, 3575, 3576, 3577, 3578, 3579, 3580, 3581, 3582, 3583, 3584, 3585, 3586, 3587, 3588, 3589, 3590, 3591, 3592, 3593, 3594, 3595, 3596, 3597, 3598, 3599, 3600, 3601, 3602, 3603, 3604, 3605, 3606, 3607, 3608, 3609, 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3618, 3619, 3620, 3621, 3622, 3623, 3624, 3625, 3626, 3627, 3628, 3629, 3630, 3631, 3632, 3633, 3634, 3635, 3636, 3637, 3638, 3639, 3640, 3641, 3642, 3643, 3644, 3645, 3646, 3647, 3648, 3649, 3650, 3651, 3652, 3653, 3654, 3655, 3656, 3657, 3658, 3659, 3660, 3661, 3662, 3663, 3664, 3665, 3666, 3667, 3668, 3669, 3670, 3671, 3672, 3673, 3674, 3675



As you know, buyers of such light planes as Cub, Taylorcraft, and Aerona have several different makes of engines from which to choose. And, as experienced by Mr. Bennett, whose company led the country in Cub sales last year, they are going Lycoming. This is not surprising, for with a Lycoming 30 or 65-horsepower engine pilots of light planes enjoy remarkable smoothness, ready response to the throttle, and dependability. . . . Ask your Aerona, Taylorcraft or Cub dealer for a Lycoming 30 or 65 demonstration and you'll learn why. . . .

YOU CAN RELY ON
LYCOMING
50 to 500 H.P.
 *Engines*
FOR MILITARY

FREE LITERATURE—Illustrated folders on Lycoming light-plane engines may be obtained from all Taylorcraft, Cessna and Aracoma dealers. Or write Department A99, Lycoming Division, Aviation Manufacturing Corporation, Williamsport, Pa., U.S.A. Cable address Aviacom.

See the Locomotive Exhibit in the American Building at the New York World's Fair

世界日報社印
1977

BENDIX AIR RADIO NEWS

JULY 1988

Published by BENDIX RADIO CORPORATION, Baltimore, Md.

Cable Address: BOWFLAD

AMERICAN EXPORT SURVEY SHIP EQUIPPED WITH BENDIX RADIO



Choice Proves Value of Modern Multi-Band Radio Communication and Direction Finding

Continuous Contact Maintained
With Both Land Stations
and Surface Ship



Callous to a Navy pilot and wife



Mr. W. B. Cawcwell, President of the American Export Lines, subsidiary of the American Export Lines, whose steamships ply regularly across the Atlantic.

Mr. Fred Rabinowitz, Chief of Communications for the American Export Company, Mr. Stephen Baker was formerly with the Civil Liberties Administration.

Captain Peter J. Hayes, of the American Express Airlines Flight Laboratory, represents personal satisfaction with the operation of the advanced radio transceiver.



PAN AMERICAN PIONEERING IN TRANS-ATLANTIC SAFETY. The new Pan American High Frequency Control System, American Flag, installed at Cribben Park, Md., by Radio Inc. developed for Trans-Atlantic through the Communications Department of Pan American Airways. Accurate heading taken on The American Clippers have greatly increased navigation on land routes.



Editorial Office: *Journal of Management Education*

SCOTT CONTROLLED BEAM TRANSMITTERS. Fast supply 100 watts output in any of 12 frequencies to be used in radio. Made in U.S.A. by the specialty position. Special features: Two 100 Watts per Hour efficiency. Power supply for Transmitters and Receivers are in the lowest cost. Transmitters and Receivers are completely in the field as described.

BENDIX—STANDARD FOR THE AVIATION INDUSTRY

MORE THAN

SIoux VALVE TUBE
GRINDING MACHINE
WET GRINDER



In production, built-in, water-cooling feature creates a New Standard for valve tube grinding of delivery up to 8" diameter, very close . . . produces accurate, more finished jobs . . . makes precise work easier and faster . . . returns wheel dressing in a minute.

SIoux No. 632 Valve Tube Grinding Machine Wet Grinder comes complete ready to operate.

SIoux AIRCRAFT **DUAL ACTION**
VALVE SEAT GRINDER

This highly developed hand and power grinder offers the modern, simple, convenient method of grinding smooth, more valve seats, with accuracy . . . after seat, hardened steel, bronze or stainless. The device operates in reference to any angle. Universal, never requires an AC or DC. This makes it the



Write for full information

STANDARD THE
ALBERTSON & CO. INC.

WORLD OVER

SIoux CITY, IOWA, U.S.A.

AVIATION
July 1954
5

50
TRANSPORT LINES
MANUFACTURERS
AIRPORTS

USE one or more

SIoux
AIRCRAFT
TOOLS

QUALITY
FIRST!



• Even though the type, size or ultimate usage may be entirely different, all New Departure ball bearings are identical in one respect—each is built to the highest standard of quality known to the industry. New Departure's factory slogan, "Quality First," is reflected in the extra service and dependability for which they are famous. . . .

New Departure, Division General Motors Sales Corp., Detroit, Conn.
1711

NEW DEPARTURE
THE FORGED STEEL BEARING

AVIATION
July 1955
7

STAINLESS

— is the order of the day!



Helps America's aircraft maintain leadership in safety, lightness, strength

AMERICA is justly proud of her record in aircraft. Her fast-developing industry, aircraft production has grown in a few short years from its infancy to a point where now the entire world purchases American-made ships.

This world leadership is a product of choice of good materials, but of the well-known American sign its progress. Yet designers and builders have not been satisfied with old materials and old methods. You have been quick to discard the old and adopt the new, whenever you could be shown definite advantages.

Today's outstanding example of advancement is the adoption of lightweight STAINLESS STEEL.

For example, in this Severely "Executive," "caddies, aluminum, and aluminum are built up from steel and tubular members of U. S. S. Stainless Steel, and sheathed in the same metal. Laminated assembly is spin-welded, resulting in smooth, finished surfaces that require no paint, enamel, or lacquer to protect them from the ravages of time and weather.

That's why stainless is the order of the day. Write today for complete data on U. S. S. Stainless Steel!

How is an exhaust manifold built, made of steel, stainless steel, or U. S. S. Stainless Steel? The latter is constructed from sheet metal and welded in the form of a U-shape. It is then covered with a thin layer of stainless steel. This method gives manifold in this form great strength, with minimum weight. It is also U. S. S. Stainless Steel, and is built in the shape of a U-shape, with a thin layer of stainless steel covering the entire surface.

Aluminum tubes fabricated from high quality surface of U. S. S. Stainless Steel, built in the form of a U-shape, and welded in the form of a U-shape, give manifold in this form great strength, with minimum weight. It is also U. S. S. Stainless Steel, and is built in the shape of a U-shape, with a thin layer of stainless steel covering the entire surface.



STAINLESS STEEL

AMERICAN STEEL & WIRE COMPANY, Cleveland, Chicago and New York
CARNEGIE-ILLINOIS STEEL CORPORATION, Pittsburgh and Chicago

NATIONAL TUBE COMPANY, Philadelphia

Chicago Steel Company, San Francisco, Pacific Coast Steelworks

Steel Pipe Products Company, Chicago, Wisconsin Steelworks

United States Steel Corporation, New York, Export Steelworks



Send for this booklet to steel service. It contains the latest information on stainless steel, its uses, and its advantages.

UNITED STATES STEEL

AVIATION

JULY 1936

9

Every Day **THREE MORE STINSON 105's GO ALOFT!**



The Reliant



In the new 105B model of this famous airplane complete of new built Stinson features that have been properly constructed. Includes 100-horsepower engine and retractable landing gear. The Stinson 105B is the standard of the industry.

Free!

Send for one copy of this Stinson News Sheet. It gives complete details of the 105B Reliant and the new Stinson 105C, including every interesting illustration.



Only the name of Stinson could induce such a spontaneous flow of orders for a new airplane! A few months ago, a simple measurement of the Model "105". Today, the Stinson plant operating day and night, with added personnel to guarantee delivery.

Everything that Stinson stands for in the aviation industry—proven reliability, flawless styling, low maintenance costs, extreme comfort, complete range—finds complete expression in the new Stinson Stinson "105". It has the same background of engineering skill and manufacturing facilities that for years has made the Stinson Reliant the standard for rugged safety, economy and luxury in private air transportation.

Now, thousands more can enjoy the real thrill of flying a Stinson, for the price of the new "105" is unbelievably low. Only \$2995.00! A new low cost Stinson plane is available if you wish to buy out of season. A trial flight will convince you that it is the plane you will be proud to own. Write, wire or phone the factory for the name and address of our nearest representative. He will gladly arrange a demonstration at your convenience.

*Including Federal tax, and including state or local taxes.

STINSON AIRCRAFT DIVISION

AVIATION MANUFACTURING CORPORATION, WAYNE, MICHIGAN, U. S. A.

THAT SHUT OUT WORRIES



All stressed cognomina, indicated with white circles in the picture above, are named and/or broken by Nickel.

Nickel is privileged to serve your industry in many different ways. A significant example is growing use of stainless steels of the 18% chromium-8% Nickel type — for wings and fuselages. Properly processed, these Nickel alloy steels combine excellent corrosion and fire resistance with high mechanical properties.



2009

Wright et al. 1999

THE CURRENT AMERICAN AERONAUTICAL MAGAZINE

NEWELL AND EDWARDS

[illegible][illegible][illegible]

Publication handling: unless this is stated, *Behavioral Science* (Boulder, Colorado) and *Latin American Studies* (Boulder, Colorado) are the journals of the publisher. For all other journals, the publisher's name and address should be given. For example: *Journal of Latin American Studies*, Cambridge University Press, 32 Avenue of the Americas, New York, N.Y. 10013-2473, U.S.A. Please do not send material to the publisher's New York office unless you are sure that the publisher's New York office is the correct address for the journal. Please send material to the publisher's London office unless you are sure that the publisher's London office is the correct address for the journal. Please send material to the publisher's London office unless you are sure that the publisher's London office is the correct address for the journal.

A MCGRAW-HILL PUBLICATION

Bendix Landing Gear Equipment Minimizes Maintenance Expense



This is why:

For more than ten years, an intense re-study of our customers' operating and maintenance problems has been carried on by Bendix.

As a result, Bendix Pneumatic Shock Struts, Wheels, Brakes and Servable and Steerable Tail Kneuckle Assemblies have been repeatedly rewarded in design. Manufacturing methods and control of quality have been advanced again and again, as fruitful Bendix research has found various ways of betterment.

Bendix service representatives, carrying on a constant survey of aircraft operating conditions, are aided through regular personal contact with Bendix engineers in solving the varied problems that arise. Field service procedures have been steadily simplified and streamlined, and service manuals made clearer and more complete.

This is why Bendix Landing Gear Equipment minimizes maintenance expense, as well as reduces the frequency of service requirements.

While you
are designing the
undercarriage

Call Bendix!

BENDIX PRODUCTS DIVISION
OF BENDIX AVIATION CORPORATION · SOUTH BEND, INDIANA
AIRPLANE WHEELS · BRAKES · PILOT SEATS · PNEUMATIC SHOCK STRUTS



EVERY BODY IN A WHOLE lot wonder what ever happened to that woman who failed to go after the "cup of groovy" all over the "cupboard" of history. It is all so new, thereby saving us the "stranded" weight of the "cupboard". There was a man with a lot.

A woman came from the "cupboard" of history, thereby saving us the "stranded" weight of the "cupboard". There was a man with a lot.



It was in the "cupboard" of history, thereby saving us the "stranded" weight of the "cupboard". There was a man with a lot.

"Maintenance will scrape and off to point it from the "cupboard" of history, thereby saving us the "stranded" weight of the "cupboard". There was a man with a lot.

Our definition of "Side Slips" is: a woman who failed to go after the "cup of groovy" all over the "cupboard" of history. It is all so new, thereby saving us the "stranded" weight of the "cupboard".

On the "cupboard" of history, thereby saving us the "stranded" weight of the "cupboard". There was a man with a lot.

There was a man with a lot.

There was a man with a lot.

There was a man with a lot.

Two years ago, the boys began climbing the world's records for "side slips". The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips". The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".

The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".

The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".

The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".

The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".



The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".

The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".

The first time, a boy from "Side Slips" (U.S.) would have to pick up a new building in which to live all of the old records, which were "side slips".

★ ★ ★ ★ ★

AVIATION for July, 1939 ★ ★ ★ ★

MAINTENANCE for SAFETY

A Message to the
Airline Maintenance Committee

By **Sampter Smith**

Chairman, Air Safety Board Civil Aeronautics Authority

REYNOLDS Maintenance Award trophy
fellow in 1938, which went to United Air
Lines for the year 1938

United's superintendent of
maintenance. Jack
Waters.



United Air Lines' executive
model at accident, Ray
Delaney.

The Chapman ship crewed. In order to show who operates maintenance and
aviation at the time

The airlines of the United States lead the airlines of the world in safety of operation. Much of the credit for this excellent performance record can be attributed to the cooperation that has existed between the maintenance departments of the various airlines, which is best exemplified by the hard work of the maintenance committee.

With interest, I have followed the work of the maintenance committee. This has been particularly true this last winter when government forces joined with the airlines in a concerted safety campaign. Everyone is now aware of the results; the airlines started a new standard of safety for operations during the period of the year which previously had the poorest safety record. Complete cooperation, careful coordination and stringent regulations on the part of the Civil Aeronautics Authority backed by critical, unbiased investigations conducted by the Air Safety Board would not have given the results obtained without the excellent cooperation and hard work of the airlines, particularly maintenance departments.

For the past five or six years the work of the maintenance departments of the various airlines has been coordinated by the maintenance committee. Ideas have been exchanged; problems have been discussed; and when one line has failed in a complete solution, another line has been found the answer. Consequently, the experience of all lines has been made the experience of each line. Their maintenance work has been coordinated and the results have been a great deal more effective.

The maintenance committee is a unit, and each individual member of the committee is to be congratulated for the part they have played in establishing the airline operation safety record, and a special word of praise is to be said for the Air Transport Association in the coordinating work of its member of the committee.

The work of the maintenance departments of the various airlines has not only resulted in establishing new records in safety of operations, but in these departments goes much of the credit for the development of new, more dependable and efficient power plants. Close cooperation between engine manufacturer and airline maintenance personnel is responsible for this development. Through this creative work of the maintenance departments, contributions have been made to general aeronautical development and thereby to the national defense of this country.

While the work of the maintenance departments is to be lauded, they still have a job ahead of them. If they do nothing else, matching their past record will give them an appreciable task. I have confidence, however, that they will go still further under the continued guiding hand of the maintenance committee. New developments will bring new problems and some of the old problems have not been totally solved. It is to be remembered that one accident costing life and property is too many, and a vigilant guard against such occurrences always must be maintained.



Who's Who IN AIRLINE MAINTENANCE

Probably the greatest contribution to airline safety in America has been through the cooperative work of the Maintenance Committee of the A.T.A. Here is the story of how it will come about, by the man who has been largely responsible for the remarkable success of the whole project.

By Fowler Barker

Secretary, Air Transport Association of America

THE Air Line Engineering and Maintenance Committee has been functioning with considerable results for eight years. Things happen in rapidly in air transportation that demand confidence of this sort are too far apart, even though they are held each six months. Were it not for the fact that members of the committee continuously exchange information, the semi-annual meetings would be too infrequent.

The maintenance chief at each U. S. air line is a member of the committee. In recent years when the air lines either elected these men to the title of chief engineer or employed chief engineers, the latter have been taken into the fold. And it is a "fold," the committee is a closed corporation, has been a good job and knows it. Several of the original members are still "in good standing." Luther Harris, now of Pennsylvania Central, was the first chairman when the committee was organized in 1931 under the Association of Chamber of Commerce with William Reinhold as secretary. And

Frederic is another charter member and a valuable contributor.

Walter Blumstein of TWA, one of the original members, was chairman from the Kansas City meeting of June, 1933, until the Hollywood conference of 1936 when he was succeeded by H. Q. West, now of Trans-Canada Airlines, who, at that time, was in charge of Engineering and Maintenance for United Air Lines. It was Oliver West who emphasized the two-year plan beginning with the Boston meeting held in July of 1937, thus dividing the scope of the meetings,

most friendly at first, to (1) making plans for the future (engineering for the long pull) and (2) solving maintenance problems. Great credit is due Lyle Harris and Walt Hamilton for keeping the meetings on the informal basis of round table free discussion of troubles and how they were being licked or had been licked by one or more operators. This is for the benefit of all, and due to the suggestion of Colonel F. S. Derrif, President of the Air Transport Association of America, pertinent air line technical data in recent years have been made

Strictly Confidential

ALTHOUGH "strictly confidential," here are some of the high spots which can be talked about, gleaned from recent meetings of Airline Engineering and Maintenance Committee conferences. Average air transport engine power output has been increased 125 per cent in the past ten years . . . Four o'clock at least in 35 airlines was believed better in present production engines than three o'clock in 1930 engines . . . Recommended that high high engine be colored green, and 17 engines, blue . . . One new model transport has one mile of control cable and twelve miles of electrical wiring . . . The committee recommended that a marking strip be placed on tubing to show whether twisted . . . (Before the next meeting, this was done by an alert maintenance man) . . . Pilots should leave flaps down until speed is slackened in order to save brakes . . . Mineral oil, because it doesn't vapor-lock, is a good fluid for hydraulic systems . . . Heat from the pilot's breath affects the accuracy of sensitive altimeters . . . By the simple expedient of reducing the diameter of a pulley, engine wear made to idle properly . . . Air transport are flying between two and three thousand hours a year . . . In 1937 the air lines used more gas and oil than the Army and Navy combined.

available to the private flier and the so-called commercial operator. Prior to the time that Douglas equipment was so universally employed as it is today, the maintenance chiefs and/or engineers of the air line, including the Dutch, "went to school" to Whitt, who gave them, confidentially, what they needed to know before placing DCA's in operation. The same supervisor spent his period at the Cornell and applied to North-west's experience with Martins and American Airlines' with the DC-3. But air lines passed on their valuable

experience to the others. Pan American Airways, through Master Practitioner, Lufthansa, TWA, and United, and so on, have always been active and the outcome of co-operation in giving the latest the benefits of their experience. Royal Sundell succeeded West as Chairman and did an amazingly good job, especially in facing up speakers for the Cornell and open sessions. Among these speakers, beginning with and since the Dallas meeting in July of last year have been Jim Do-

herty, Bill Helmer, and Doc Harwood on a comparison of the high altitude engines, Wire Price of Boeing on four-engine jobs, Igor Sikorsky on designing for the future, Andrew Wiggin and his brilliant insight on engine design trends, Sam Shuchman on vibration and engine mounts, Colonel Randolph on standard staff, Edna Adams on training crews for the big ships. S. Paul Johnson was especially interesting when, on two occasions, he reported his European experience. On the most recent occasion the Committee accepted the "Saturday Evening Post" and "Herald Tribune" by special words which it knew what Paul had to say about European aviation with emphasis on technical developments and maintenance practices.

Conferences of the Committee with which the writer has been associated have been held at Atlanta (December 1933), in Chicago (July 1934), Bloomington (January 1935), Detroit (July 1935), Miami (January 1936), Hollywood (July 1936), Dayton (January 1937)—how many conventions have been started to hold their meetings at Wright Field in Dayton (July 1937), Dallas (January 1938), Chicago (July 1938), and New York (January of this year). It will be noted that at each place with the exception of Wright Field, Do-erty and New York—there has been an air line maintenance man. Wright Field and the Bureau of Aeronautics and the Navy Department have for years collaborated closely with the air line on the subject of maintenance, and it was none other than Captain C. S. "Shag" Travis of the Air Corps who left off a prepared paper as a speaker before an open session at which all delegates to the Conference, including manufacturers, aviation schools, college professors, and others were invited to sit in Captain Travis'



LUTHER HARRIS,
First Vice President, Maintenance Committee,
Maintenance Engineering, P.C.A.

WALTER HAMILTON,
Deputy Vice President, Maintenance TWA,
Now with Douglas Aircraft

OLIVER WEST,
Former Maintenance Dept., P.C.A.,
Now T.C.A.'s Chief Engineer

HUMPHREY ROOMEY,
Ex-P.C.A. & B.V.,
Now Division Engineer, P.C.A. - Miami



CLARENCE HELMS,
Formerly with Lockheed,
Now Dept. of Maintenance, P.C.A.,
& well old timer in the business

JAMES LANGSTON,
Now Director Superintendent, P.C.A.,
& well old timer in the business

B. M. GRAHAM,
Who heads up Cornell and Maintenance
with Cornell University

PAUL MUDGE,
In Charge of Maintenance Operations
on Continental Airlines



paper delivered at Miami is still considered to be the prime for manufacturers as designing an airplane to take into consideration their customers and the maintenance of the whole.

Luke Harris informs me that the first meeting was held in Detroit during the airshow show in 1931. The second meeting was held in St. Dallas in December of that year, the third in Chicago in July of 1932, and the fourth in Miami the following September. The Conference have printed newsletters each year, the most recent one in New York being written by approximately 200 leaders in aviation from a national viewpoint.

Standings among visitors who have been present at the majority of these conferences are Roy Jones formerly of Kellogg and now of Princeton, Carl Schreyer of Hawthorn-Donaldson, who, for years, has acted as chairman of the manufacturers' group and often met in leading the visitors into the conference at the proper time, Jack House of Pratt and Whitney, Bill Kennedy and Ken Buehler of the Navy, George Feltz of the Navy and Sam Lindsay of B.G., and the rubber manufacturers—Larry Gauthier, Roy Brown, and Jim Deane of Goodrich, General and Charles, respectively. Decker and "Mike" Taylor several years ago worked closely with Committee members in developing a new design for the Navy.

Representative of the Cleveland Pneumatic Tool Company has been a regular delegate. Indeed, it isn't a maintenance conference but a design conference. Carl Spahr has represented Lockheed at these meetings for years, as did Carl Cole who he was with Douglas but who has since relinquished some of the roles of Committee members representing Transair Air Lines, along with Charles Frasier who has taken an active part in Chairman of the Air Transport Association Committee on Aircraft Fire Prevention and Protection. The Board member are always in uniform, including Texas and Louisiana, Kerv and Melvin of Kellogg and Buehler, respectively, and to stop Decker and even John Cawley himself, George Hakeham of Walter Kofke, who, at the New York conference was flanked by Dr. Freygang,

Maintenance Garden Party—
Dr. Ed Work and Dr. Play Mikes (Jack a Bull Bull). General Gurrell presiding the July 1935 Conference at his Beach House, Florida. (Photo by George Feltz, S. G. Co.)

1. Roy Knudsen (P.A.A.) and Ed Feltz both to see on procedure, while Knudsen and Feltz both were already into their line.
2. The photographer interviewed an Isom, Knudsen (P.A.A.), Ed Feltz (General), and Ed Feltz (General) standing for the latter. The gentleman with the microphone represents to the left Knudsen, to General Feltz, S. G. Co.
3. Roy Knudsen (P.A.A.) and Ed Feltz (General) standing for the latter.
4. Ed Feltz (General) standing for the latter.
5. The speaker had welcome note of the

has been a familiar figure at these meetings. Not all who were attended, and considered in, these conferences are mentioned in this article, their interest and help is invaluable appreciated.

The participants, strongly, and met for purposes of salesmanship, have been well-represented for years. Such names as G. French, now a big red, and C. G. French, have been attended by Knudsen, representing Knudsen, as a regular delegate. Decker and Joe Winkler of Shell, Ed Adams, and Bob Rife of Standard Oil, Colman Ladd of General Electric, Ed Adams, "Doc" Embree of Gulf, Major Victor of Pratt Co., Dick Brundage of California, and Ed Adams, Philpott of Kernal, Auland Katz, Dick Jennings, Peter Glenn, and "Doc" Hakeham have represented Transair also. "Doc" Hakeham represents a true scientific manner—not in the least over the heads of the Committee. J. E. Long and "Tom" Knudsen of Transair, W. E. Townsend and others of the Crusader Oil Company have been steady and have contributed materially and valuable. Compounded and interest from the was the theme of one of the meetings, and high quality always comes in for its share of attention.

It was brought out at the Dallas Conference in January of 1935 that there were twelve grades of aviation

1. The speaker had welcome note of the
2. The speaker had welcome note of the
3. The speaker had welcome note of the
4. The speaker had welcome note of the
5. The speaker had welcome note of the
6. The speaker had welcome note of the
7. The speaker had welcome note of the
8. The speaker had welcome note of the
9. The speaker had welcome note of the
10. The speaker had welcome note of the
11. The speaker had welcome note of the
12. The speaker had welcome note of the

hubs. The Committee, in collaboration with others concerned, has been active in reducing that number. There has been a lot of talk about the effect of the act of 100-ounce position on the carrying point of the air line. In addition, the Committee, with ability, have been stressed at each one of these meetings, and that high-ounce situation is but one of many items considered which have a bearing upon maintenance of operation.

The Committee has had the honor of having the presidents of some of the largest vendors in attendance, including Mr. Edgar of the United Fruit, Mr. W. O'Neil of General Tire and Rubber Company and Bill Ladd of the upholstery and various national firms, to well represented by Ed. Ed. Griffin, have attended the sessions in one time at another at his Mr. E. H. McMillan as president of the Transair Line Company.

Mr. T. E. Smith of Transair Air Lines, Jack Feltz of Transair, and W. E. Townsend of Boston-Maine are among the representatives who have attended these sessions, the first mentioned having attended two of the meetings. Other names, including Ralph Dunn, Moore, Snyder and Richardson of P.A.A. and Jimmy Jones of Western Air, have attended sessions, the last mentioned acting as chairman in Chicago in 1934 in place of Bill Knudsen

who was busy accepting delivery of DC2s at the time.

Dr. George W. Lewis of the M.A.C.A. and Dr. Jerome Knudsen of M.E.T. have also attended, the former on several occasions and, when he cannot be present, he sends a representative from the laboratories at Langley Field. Jerome Knudsen of Aero Insurance Underwriters is always a welcome visitor and has contributed a lot, a worldwide view, especially in making on data to find the cause of the accidents, they wanted to take a chance on doing some of their customers, it was only with the committee.

At the Chicago meeting six months later even some manufacturers showed up. One met down in the conference room and to his embarrassment and was told to be "sister" out.

Since the Armed Forces Chamber of Commerce of America represented both manufacturers and air lines and since the manufacturers were to their spokes, being dressed rather shoddily, the committee authorized us to the attendance meeting in January of 1935 to where manufacturers were they would definitely be invited to follow the conference to "tag their piece" but that sales agencies and sales personnel would be strictly asked to leave. Since and excluding the 1935 meeting of 1935 the conferences have been conducted under the auspices of the Air Transport Association.

This worked extremely well. Mr. Evelyn Buehler, head of the aviation Division of Pan American attended the winter session, and commanded the session on the day when the conference was conducted. Jack House of Pratt and Whitney was especially helpful at the meeting in establishing the day in that handling of Wings—occasionally used at that time in Florida and other shops. Bill Knudsen, as usual, seemed to be attending. In fact, he and Ken Buehler had become so enthusiastic about these meetings that they sold Arthur Nix, chief engineer of their company, on attending the meetings. Art hasn't missed one a recent year. It was at Knoxville that a meeting room was first provided for manufacturers.

A typical session was that of the

The independent phase of the very drastic this conference cannot call progress very rapidly. And the methods of conducting the meetings have changed as they grew. Since the manufacturers of airplanes believe they should be in at all times and that by so doing they and the air lines would benefit. This idea undoubtedly has considerable merit and a vote will be taken on this point by committee members before the next meeting.

The committee has certainly benefited by having Henry Compton, vice member J. E. Sullivan and various others of the Bureau of Aeronautics. This idea undoubtedly has considerable merit and a vote will be taken on this point by committee members before the next meeting.

A little history of the conference and how they grew like the proverbial tale of Jack and the beanstalk

They began in 1931 as strictly for air lines and no one else. At the Atlanta meeting in 1933, when the committee was first associated with the manufacturers, representatives congregated at the hotel where the meeting was held. They were left out in the cold and did not even have an automobile provided for them. It didn't dawn on me that they needed this, but it was "sister" air line" and it, during the course of the conference, they wanted to take a chance on doing some of their customers, it was only with the committee.

At the Chicago meeting six months later even some manufacturers showed up. One met down in the conference room and to his embarrassment and was told to be "sister" out.

Since the Armed Forces Chamber of Commerce of America represented both manufacturers and air lines and since the manufacturers were to their spokes, being dressed rather shoddily, the committee authorized us to the attendance meeting in January of 1935 to where manufacturers were they would definitely be invited to follow the conference to "tag their piece" but that sales agencies and sales personnel would be strictly asked to leave. Since and excluding the 1935 meeting of 1935 the conferences have been conducted under the auspices of the Air Transport Association.

This worked extremely well. Mr. Evelyn Buehler, head of the aviation Division of Pan American attended the winter session, and commanded the session on the day when the conference was conducted. Jack House of Pratt and Whitney was especially helpful at the meeting in establishing the day in that handling of Wings—occasionally used at that time in Florida and other shops. Bill Knudsen, as usual, seemed to be attending. In fact, he and Ken Buehler had become so enthusiastic about these meetings that they sold Arthur Nix, chief engineer of their company, on attending the meetings. Art hasn't missed one a recent year. It was at Knoxville that a meeting room was first provided for manufacturers.

A typical session was that of the



Dallas conference of July 1935 which conference was assisted by twenty or fifteen men representing interest air lines, including the Dutch KLM, and representatives of the Bureau of Aeronautics, law officers and civilian engineers from Wright Field, two came from the Naval Bureau of Aeronautics and six or seven representatives of manufacturers. Major R. W. Schenck (from your list)

Check AND DOUBLE CHECK



The existing requirements met by manufacturers in building Air Corps machines are matched by methods of maintenance in service. The author has had long experience in maintenance work in the Army. He is an Honorary Member of the Maintenance Committee.

By Captain Clarence S. Irvine

Air Corps, U. S. Army

THE LAST TEN YEARS have brought far-reaching changes in the equipment of the Air Corps. This progress trend toward the use of all-steel low wing configurations of high performance has included both tactical and all-weather training types and has resulted in a drastic metamorphosis of maintenance problems and policies.

The use of highly supercharged engines for power and better thrust, and emphasis on performance by the majority of other types has intensified the problems of engine maintenance. The emphasis on performance and all-weather flying has resulted in the installation of a bewildering array of highly complicated accessory equipment. Motor flying and landing instruments, remaining landing gear, wing flaps, control system and fuel boosting equipment, automatic primer and mixture controls, those and many other items, all add to the magnitude and scope of the problem.

The day is gone of the good old-fashioned crocheted, jack-of-all-trades

—who proudly boasted that he knew the length and breadth of every stick in the barn and every good joint in the physical of the wing span.

The high and exacting standards of maintenance and inspection required in our present day Air Corps, coupled with the fact that the art of aviation now requires almost every phase of engineering, has forced the issue. The Air has come to specialized training, and concentration in clearly defined fields of endeavor. In our technical schools at Maxwell, Tuskegee, through training a pilot in electricity, mechanics, hydraulics, typography, engine, instrument systems, communication and armament. While the theoretical phases are covered in sufficient detail to give a good basis of understanding, the emphasis is placed on practical application to the care of engines and equipment in the field.

Standard repairs on airplanes in the past were usually performed by a workman with his glue pot, and a thieft's vector with his screw and dope-brush. Now a sheet metal worker or with a bending bar, a pair of tin snips and a handful of bolt-headed screws took the center of the shop when repairs are needed.

Now for a brief outline of the processes and unsupervised control back of the men who grow our fighting ships.

To the Field Service Group of the Materiel Division at Wright Field has been delegated the responsibility for the administrative and technical control of storage, issue, overhaul and maintenance of Air Corps equipment. The basis of inspection, overhaul and division is the Technical Order system. Separate technical orders are issued for each series of type of airplane, engine, or item of armament or auxiliary equipment. These T.O.'s are divided into sections pertaining to flight operation, field maintenance and inspection, tests, overhaul, and parts lists. They are issued in book and form for technical revision.

The actual storage and issue of supplies, and the overhaul and repair of equipment, has been decentralized in four major continental air depots, and three smaller air depots. In order to keep the maintenance in shops, and prevent obsolescence, only sufficient supplies for short periods are stocked in the warehouses at operating stations and air bases.

In view of the expensive facilities

both in structure and equipment, as well as the trained overhaul personnel necessary for the performance of major overhaul activities, Air Corps policy has tended to sharply limit work done in the field to only primary inspection and maintenance.

The industry has increased in recent years, to anticipate and be controlled by careful inspection, and to fly the complete airplane in an Air Depot whenever extensive overhaul or replacement is necessary. Experience has shown that the procedure is prefabricated in the past, when airplanes were completely dismantled and disassembled for overhaul, in no longer necessary or desirable on all-metal airplanes.

For ground between major overhauls has been greatly increased. In fact, some criticism has been heard to the effect that our airplanes are as well built and maintained, that their useful life will be over ten years. This for tactical types, means that they will still be capable long after performance of most modern types have made them tactically obsolete. However, they may still be used for training purposes in the hands of their commercial operating life.

A far flung air transport system now common to the air depots with the larger air bases and stations, and provides close support of extended tactical operations away from home stations. Air transport service is thus available for the transportation of maintenance supplies in the field, and the quick return of unserviceable equipment to the air depots.

The Visual Inspection System is the backbone of Air Corps maintenance in the field. This system not only provides a constant check upon the operating condition of each aircraft, but also provides a guide to make adequate maintenance at proper intervals. It greatly simplifies the thorough training of mechanics, and affords supervisory personnel a quick and convenient check upon maintenance efficiency.

A visual checklist is carried in each aircraft, in which appropriate actions are made by flight pilots and maintenance personnel.

Complete records are kept by the crewchief of each aircraft, including flight data, servicing, inspection and maintenance operations; and changes in or replacement of items of auxiliary or accessory equipment. These records are kept in such form as to be readily available for check at inspection by supervisory engineering personnel.

The primary responsibility for the determination of the adequacy of maintenance, and the operating condition of each aircraft rests with the inspection or check thereof in which the airplane is engaged. Inspection and maintenance functions are performed at regular periods known as the Pre-

Flight, Daily, 20 Hour, Weekly or Special, and Engine Checks. Prior to the first flight each day, each engine is given a 15-minute inspection and engine warm-up. At this time a thorough check is made of engine operation, fuel, oil and cooling systems; engine and engine controls; engine and flight instruments, servicing of fuel and oil, security of fuel and oil caps, doors, mechanisms, etc.

The Daily Inspection is a visual inspection to determine the general condition of the airplane. It is intended to detect apparent conditions, maladjustments, etc., which may lead to interference with the reliability but is not intended to be sufficiently thorough to detect slight wear or minor discrepancies.

The 20 Hour Inspection, which includes the Daily Inspection, is designed to be thorough and detailed. All parts are inspected to assure that they are in good condition and functioning properly, and that routine maintenance operations have been performed. This inspection is necessary during actual working hours, and without withdrawal of the airplane from regular service.

The 20 Hour Inspection includes the Daily and 20 Hour Inspections and is designed to be a very thorough, complete and searching inspection of the entire airplane. It need not be performed in a continuous operation, a reasonable time being allowed, in order to avoid limiting flight operations under as possible. At this period or multiple thereof, extensive maintenance operations are performed. For example, engine valve adjustments are checked, track pins are renewed for shock and cushioning, operation and mechanism of retracting landing gear are checked; propellers checked for balance, cracks and pitting; control surfaces checked for proper balance and control; engine mounting bolts checked for security, repair and strain; control system checked and checked for wear or excessive loss of motion.

A visual checklist is carried in each aircraft, in which appropriate actions are made by flight pilots and maintenance personnel. In case of chronic engine trouble, following at one time, special inspection may be set up, in connection with the determination of the cause and the solution thereof.

The Engine Check inspection is an action at the time the engine (or engines in a multi-engine airplane) is changed. The reported condition of the engine, its type and model of engine is covered by special instructions applicable to the particular type of engine. Maladjustments are reported, or service conditions are found at overhaul, the

period may be reduced. On the contrary, incident from difficulty, and accelerated operation of a test number of engines over a longer period, is used to justify maintaining the running time before overhaul.

At the time of engine change it is customary to replace or recondition the major items of accessory equipment, such as generators, vacuum pumps, and starters. Instruments are thoroughly checked, and reconditioned or replaced if necessary. The entire airplane structure is completely gone over and much work accomplished that in past years would be considered as a minor correction. This has been recognized by the fact that present day airplanes can operate satisfactorily for extended periods between depot overhauls.

In order to obtain a completely uniform and standardized technical inspection of methods, procedures and systems employed throughout the Air Corps, the Chief of Air Corps relies upon the Inspection Section of his office. This Section is charged with



Periodic maintenance is an important part of the Army's program.

NOTE—The operators in quarters pictured in the top left are not to be confused with official Air Corps personnel. They are Air Corps or Air National Guard personnel.

The development of systems for increasing the standard of maintenance of Air Corps equipment and installations; the assurance that all flying equipment is maintained in a serviceable and airworthy condition; that only authorized changes are made in equipment; and that those changes are made at the time and in the manner prescribed; that records, reports and files are properly prepared and maintained; in summation, that all administrative and technical instructions are fully and properly complied with.

In order to facilitate the carrying out of technical responsibilities, service has been decentralized in each Air Depot Control Area. In such units, areas, operating directly under the Inspection Division, U.S.A.C., are offices known as "Technical Supervisory Units." In addition to technical supervision and supervision of activities within their areas, they are also responsible for coordination and liaison between field activities and the Air Depot of all matters pertaining to the technical condition of equipment, the desirability of overhaul and related matters.

In an organization utilizing the tremendous amount and variety of equipment necessary to the fulfillment of the Air Corps mission, failures and malfunctions are inevitable. In order to properly classify and record these pertaining to service, facilities conveniences at convenient locations, and within the maximum experience gained in the design and government of new equipment, a procedure was devised covering reports by the service on high rate of malfunctioning.

According to present procedure, a report is prepared by the wing representative whenever an airplane, engine or item of accessory or auxiliary

equipment fails in service, or fails to satisfactorily perform its proper function for the period contemplated by technical instructions. These reports are forwarded, together with complete factored parts or photographs thereof, through the engineering echelon at command to the Field Service Section, where the reports are classified, recorded and filed. Appropriate comments regarding seriousness of the problem, and action recommended are appended by the supervisory representative.



Monthly technical inspection by Technical Supervisors and Post Staff, Randolph Field, Texas.

entering offices through which the report is forwarded. In the event that information is available in the Field Service Section regarding necessary movements or action deemed desirable, an immediate radio or letter reply is dispatched to the originating unit. In most material on which to base a reply is not available, the report, together with all data and records pertaining thereto go to the Experimental Engineering Section for study and recommendations.



Regular 30-hour inspection and maintenance check on a Douglas A-17A, which plane of the Third Pursuit Group.

Engineering personnel then engage in much research and are passionate as to required to classify a solution to the service difficulty. If the problem is satisfactory service, the maintenance engineers, and in some cases, other governmental research organizations, are called into consultation. After the solution is arrived, the same procedure is followed as in the case of all other technical instructions. That is, the Air Corps engineers specializing in that particular phase of technological research, prepare the data for in-

struction to the service. These instructions are then issued by the Field Service Section, together with drawings as required, and distributed to the field and air depot activities.

These reports from the service have been found to be of great value, not only in the fulfillment of their primary mission of keeping service equipment in satisfactory condition, but also in the design and construction of similar items. When maintenance records are always transmitted through the evaluation of complete airplane, submitted for

provision. Every effort is made to eliminate features in new designs at service or maintenance that reports have indicated to be troublesome in service operation.

One of the most difficult problems confronting maintenance personnel is the handling of airplanes which have suffered forced landings. To care for this problem, the Mobile Repair Unit has been developed. This Unit is intended to be primarily a Depot unit where facilities in the repair of damaged aircraft in the field at some distance from depots or air bases. The Unit consists of selected personnel, provided with the Type C-2 loading truck, supplemented with special tools, machinery and instruments as required by the particular emergency.

During the early part of each year field members have been conducted at northern bases (Experimental) and Service Test Equipment, particularly on maintenance character, in line goes through and existing units under the most rigorous of field conditions. As a result of these tests (spot) accidents, and equipment have been developed that will permit smooth operation under all adverse conditions. Aircraft engine oil dilution, field working enclosures, special adaptable mechanical work stands and ladders, hydraulic jacks of large capacity; special noise reducing equipment; portable-by-air electric power plants, and many other essential items have been developed, tested and proven as a result of these and other field exercises.

It is the proud honor of the Army Air Corps, that it, like the Navy, is a "First to Be" ready for effective field operations at any time, in any direction, under any conditions of climate, weather or operating service.



Type C8 working truck and trailer. Overall length, 34 ft. Loading capacity, 100,000 lb. Capacity of trailer, 30,000 lb.

AVIATION

July, 1938

31



Type F1 reducing unit developed for the Army Air Corps. Capacity 4000 gal. 40 in 400 gal. per min.

AVIATION

July, 1938

37

Servicing OUR FLYING FLEETS



Good maintenance is the essence of safe operation on the long over-water flights that are routine for Naval air missions. The author is now in charge of aircraft maintenance in the Bureau of Aeronautics.

By Commander Felix B. Stump, U. S. N.

Head of the Maintenance Division Bureau of Aeronautics

THE MAINTENANCE of naval aircraft has undergone very rapid changes in a comparatively short time. The transition from wood to metal came almost almost overnight, and a generation of skilled woodworkers passed from the scene or shifted into the lands trade. There is a serious shortage even today of skilled personnel in the art of forming and finishing metals. From a maintenance standpoint, there are many advantages to wood and fabric and wire construction, and it has been said that newer designs to the older types could be adapted with hardly more than a pencil and thread and a piece of repair tape. Modern aircraft require a close agency in daily maintenance even for minor repairs.

NOTE—The opinion in this article is that of the writer and is not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

The power of the fleet depends upon the efficiency of its base, upon its shore facilities, without which it cannot operate. One fleet, however, is a greater asset than that of any other great nation, must be sufficiently self-sustaining to operate for months far away from its essential shore establishments. And naval aviation, a vital part of the fleet, must maintain its efficiency far away from its base by the efforts of its mobile squadron personnel, officers and enlisted men, in a greater extent than any other air force.

In order to provide such trained personnel, our overhaul shops are necessary, efficient and reliable, and efficient in commercial United States, with a greater proportion of sailors at working bases in the Canal Zone and Hawaii. The facilities of squadron maintenance centers of the officers and enlisted men who have had their year of duty in overhaul shops abroad. These they have learned to expect.

engine mechanics, metal workers, instrument and electronic men. They must constantly perform work within the limitations of their own squadron, which, in other air forces, would be done at the repair base.

Aviation in all its phases is progressing so rapidly that it is impossible to seek a well-managed aviation repair base, army, navy, or commercial, without finding some equipment (often built locally), some personnel or procedures, some method of organization or test, or some shop arrangement different from and superior to all others. Recognizing this, with great benefits in economy, efficiency and quality and with the cooperation of the army and the airlines, the navy endorses each year to have one or more of the leading personnel of each of our overhaul bases make a tour, preferably in a group, of the larger army, navy and commercial overhaul bases in commercial United States. At the comple-

tion of the tour, the personnel making it assemble at the Navy Department for two or three days for a general discussion and interchange of notes and ideas, in which various specialists and maintenance personnel on duty in the Bureau of Aeronautics participate. A complete report of the tour and discussions is then mailed to all units which would be benefited therefrom.

Travel contracts will be issued from the Mediterranean Sea to the China Coast and from Panama to Alaska. Spare parts must be duplicated where not too bulky or arrangements must be provided for quick distribution from a central agency. The multitude of articles necessary for the maintenance of fleet aircraft is supplied by the diversity of types as well as the geographical separation of the points where the material is required.

Storage problems for perishable material are acute in the tropics and the available space aboard the aircraft carriers and other surface craft is a matter of serious moment.

The checkmate of naval aviation requires a very close liaison between the program for manufacture of spare parts and the member of each type that will be required prior to the time when the last planes of a series model are scrapped. Of course, any system resulting at that time are a total loss and for the reason it is difficult for the purchasing agency to erect a policy of head to month buying for a model near the end of its useful life. Nevertheless, the timing and manufacturing costs for small quantities is terrific and it may easily be seen that a few obsolete spare parts in stock, after all phases of the model using them have been scrapped, might economically be charged to insurance.

against the possibility of manufacturing in small quantity at tremendous money cost and equally easily sold.

Standardization is of extreme importance in maintenance, primarily in securing interchangeability between various parts on various types of airplanes at different maintenance bases. Army-Navy standardization in the past has been accomplished by agreements between the Army Air Corps and the Bureau of Aeronautics. This standardization involved primarily the establishment of records of individual airplanes. Such agreements were not considered as such for procurement purposes. Under the Aeronautical Board there has been established recently a committee composed of representatives of the Chief of the Bureau of Aeronautics and the Chief of the Army Air Corps charged with coordinating the requirements of the two services to the extent that single part-

documents will be issued and purchased in such the procurement purposes by both services. This system is now in effect and airplanes will have a direct and beneficial bearing on maintenance. Interchangeability, Army-Navy standardization is not only considered in terms of the needs of the Army and the Navy but consideration is given, prior to the adoption of these standards, in making them adaptable to commercial structures as well.

CONCLUSIONS

A problem peculiar to the Navy, or possibly to the very few commercial lines which operate over salt water, is that of corrosion. Corrosion places an added, and the cruder and less sophisticated, problem on their aircraft are subjected to salt air, spray, fumes, smoke, and sun and rain for months at a time. Flying boats may be anchored out in the water for weeks in



Colleges work press speed maintenance and working problems. Left, Royal Air Force, under attack at North.

and, possibly in the high humidity of Panama or the snow and fog of Alaska.

In the past, not as much care in design as could be desired has been exercised to secure free drainage of

structures. This condition is improving, but not only is unimproving, but also is corrected every possible step should be taken to insure that water or moisture which goes across to the interior of a structure is allowed free drainage so that it may not remain and initiate corrosion.

Upper removal from salt water, a surface should be washed immediately with fresh water to remove all traces of salt. A light film of oil should be applied to the unprotected parts.

In the same way, design has not always provided for the separation of dissimilar metals and many of the defects found during operation can be tied to such errors. Properly care must be exercised to remedy such conditions without corrosion will be reduced prior to subsequent overhauls. When dissimilar metals must be used because of structural conditions, they must be protected from each other in order to prevent electrolytic action and consequent corrosion.

The present care in following approved specifications for the heat treating of aluminum alloys is important for strength considerations but a even more vital is a focus of rusting corrosion. As an example, properly heat-treated aluminum alloy 7075 has been in use in some of the latest, larger patrol squadrons for over a year's service under the most adverse conditions of contact with salt water and aging, with practically no corrosion—separately satisfying performance.

Barnacles

The growth of barnacles on the underwater surfaces of large airplanes was the trigger condition, a serious problem when facilities for readily removing the animals from the water are limited. Within a few days the growth of barnacles can become sufficient to prevent take-off without a great reduction in the normal load. Barnacles, some as large as 1 in. in diameter, have completely covered the bottom of airplanes moored for days in one of our largest waterways. The growth of barnacles seems to be fast, although still uneven, despite the use of tropical water. The presence of both river silt and sewage appears favorable to barnacle growth.

Barnacles four days old can be removed with a stiff bristly brush. Those over ten days old become very firmly attached and require wire brushing and sometimes scraping with an aluminum scraper.

The barnacles penetrate through both bismuthous paint and aluminum

brackets and attach themselves to the zinc chromate primer underneath. When bismuthous paint was covered with "Paralok-bond," there were fewer barnacles but the main advantage of the "Paralok-bond" seemed to be that the barnacles formed more easily to remove.

The following coatings over the basic zinc chromate primer are listed in order of work for the resistance to the formation of barnacles: "Silicon," aluminum bronze, black enamel enamel, with bismuthous paint, and bismuthous paint. Of these, "Silicon," as several tests have proven, gave by far the best results. It was the only one of the group which the barnacles did not penetrate and the amount formed was the least of the lot. Two coats can be applied in a large time-saved application half in forty-five minutes.

The search for improved protective coatings is in effect to reduce maintenance difficulties has always been assigned high priority by the Bureau of Aeronautics and many developments indicated by the Navy have been pointed on to commercial varieties. In particular, the magnesium anodic treatment, zinc chromate primer and a number of synthetic bronzes stand out as important contributions in recent years. The aluminum metal spray has been found very effective in protecting corrosion at sea as well as of corrosion alloy parts, and our standard overhead protection makes use of the means of protecting engine cylinders as all other and landing gear engine wheels and other of the cylinders after they have been subjected to salt spray in flight.

Exhaust

Three recent improvements in engine construction are resulting in more flight time between overhaul and engine periods.

The first improvement is the adoption of automatic valve gear lubrication. This has made possible the extension of the operating time between checks and readjustments of valve clearance from thirty hours to one hundred and twenty hours. Indications are that in some longer period may be adopted. Automatic valve gear lubrication reduces wear at the parts of the valve mechanism, particularly the relevant valve stems and guides. It is no longer necessary to replace these parts as nearly every major overhaul, which was formerly needed.

The second recent improvement is the adoption of grinding as a means of hardening cylinder barrels. Service experience has data indicate that nitrided cylinders wear as fast as the engine, thus eliminating re-grinding, and, therefore, the need for such expensive equipment and skilled work. Thus, it may no longer be necessary to carry a stock of oversize piston and rings or to relined cylinders.

The third improvement in engine construction is the adoption of pre-lubricated, lead coated steel master rod bearings, which can be installed immediately during overhaul without having to use the expensive re-lubrication and lead coating facilities and skilled personnel to operate it.

Experience shows that corrosion of engine cylinders and lead coating, within twenty-four hours after stopping an engine which has been run on produce

deposited with ethyl lead. Such corrosion is negligible in the case of engines being run continuously on the air-burner. However, when an engine is to be placed in an inoperative status it is necessary to supply it with fresh oil and run it on clean unleaded gasoline for one hour to remove all traces of ethyl lead from the cylinders and from the other parts of the engine.

Exhaust valve deterioration rapidly and for that reason overhead engines do not have exhaust valves in-situ until just before they are to be placed in service. It has been found beneficial to purchase quality wire to install valves and not to use the containers and the wire is actually needed.

One of the most useful items in a modern engine overhaul shop and in other shops as well, in inspection equipment for evaluating engine condition of steel parts. By means of it, many small cracks are found which would eventually lead to major failures and would be undetected otherwise.

The duration of the post overhaul test of engines is a source of concern to central activities. A long test is expensive in fuel and labor cost and few facilities to test such an extent. A test which is too short will not wear the engine enough to insure reliable performance. The principal concern is to have a sufficient run-in period to test piston rings properly. Post overhaul engine run-in may be reduced by having the piston rings in their respective cylinders and by using rings having a slight taper on the face, resulting in high

oil pressure on the edge, which will cause them to seat quickly. Apparently, with the use of tapered rings a run-in period of ten or fifteen hours duration should be sufficient to insure proper engine performance.

Insulators

It has been found impossible to form trained instrument men, thus necessitating training of both civilian and military personnel at the Navy overhaul bases. It has been found that careful distribution of instruments will cause in damage due to lubricant expansion and gasket shrinkage. Therefore, it is often necessary to service instruments that have never been used. Overhaulmen instruments are often more accurate than new ones, possibly because use runs down the whole job. There is an agreed level for an instrument laboratory which will accept satisfactorily throughout the range of -40 deg. F. to +100 deg. F.

Maintenance and Research

Because of constant advancement in the art of aeronautics, it is many times not possible to obtain, on the first production order, airplanes conforming to our own standards in all details of design. Although Navy airplanes are delivered to a series of rapid and thorough run-in at acceptance, acceptance has repeatedly shown that actual service operations usually bring to light the need for additional refinements. The need for such design changes obviously creates engineering maintenance problems. The discovery of the need for these changes calls

for competent maintenance personnel. Further, the advance in the problems in many cases calls for extended research in the field of maintenance and research are closely interrelated. For example, the need for a fire extinguishing device system because very little in the way of several fires originating from sparks from ships' funnels falling on airplanes while stored in the docks at aircraft or hangars. These fires have been greatly minimized recently by the adoption of a fire resistant daping system for the upper portions of fabric wings of airplanes assigned to vessels of these types.

Current operations have also indicated the advisability of offering better which means rapid handling power in both directions. Such techniques have been developed and are now standard equipment on currently produced Navy airplanes.

The Navy has been one of the pioneers in the adoption of integral tail tanks for flying boats. After airplanes in which such tanks were incorporated had been in service a short while, it was determined that a radical change in the conventional tank maintenance procedure must be effected to insure satisfactory service from them. It was found that the new compound in these tanks was especially troublesome if not properly cared for in service and that they would leak if they were completely drained and allowed to stand empty for any length of time, due to the expansion of the solvents in the material. This was corrected by keeping the tanks full with gasoline even when they were not needed in the airplanes as the action of the gasoline had a tendency to swell the foam material and prevent shrinkage of the material.

Conversion of such tanks was also discovered early in their life. Although it appeared useless at first, the trouble has been perfectly eliminated by clearing certain protrusions in the handling of the tanks to insure that only clean, satisfactory fuel is pumped into them. The interior seams of integral tanks can no longer be reached with a representative to prevent shrinkage of the foam filler. The overhaul of integral tanks which did necessitate called for considerable ingenuity as the part of maintenance personnel and in working out the solution an effective scheme for cleaning and smoothly treating such tanks in place was developed. By following these and other procedures it is but one of the Navy's experience that integral tail tanks are highly satisfactory as used in its flying boat equipment.



Radial overhead engine complete engine of stage of test prior to tests.



Very careful safety check is built around engine test of engine and accessories.

MAINTENANCE Training

Aircraft maintenance has become an engineering problem of the first order. Here is the story of how one of our outstanding schools has set up and equipped a special course for maintenance engineers.

By William M. Thompson

Superintendent of the Maintenance Engineering School
Purdue Air College

IN PERFORMING and offering a course of training in maintenance it is essential that the many changes in the design and manufacture of transport airplanes be taken into consideration. In contrast to the bi-motor and tri-motor airplanes of the earlier days, with comparatively simple structures, there now are the Lockheed 14, Douglas DC-2s and DC-3s. Recently was launched the Douglas DC-4, of 60,000 lb. gross weight, with accommodations for 42 passengers, and a top speed of 240 m.p.h.; also the Boeing 314 Clippers that are being put into service on the Pan American Pacific and Atlantic routes, with a gross weight of 82,500 lb. and a passenger capacity of 74. More than this, it is reported that one of our leading aircraft manufacturers, the Consolidated Aircraft Corporation, has completed the preliminary study of an airplane of 400,000 pounds gross weight, with accommodations for 300 passengers and crew of 30, to fly at speeds in excess of 300 m.p.h.

With airplanes of this size, it is easy to visualize the complexity of structures throughout the wings, fuselage, hulls and nacelles. These large airplanes, with auxiliary power plants and generators to furnish electricity throughout the ship and from

four to six high powered, pressure built engines, constant speed and hydro-mechanical propellers, retractable landing gears, automatic power and air-brake controls, hydraulic systems, radio pilots, radio apparatus, flame-retardant fuelled heating and ventilation systems, supercharged exhausts, more than a hundred flight and engine instruments, over 12 miles of electrical wiring and more than a mile of fuel and oil lines, in any one of the fuel systems and other accessories, every one of which must be kept in the highest mechanical state of repair to insure safe operation, will present maintenance problems which require more than mechanical skill for solution.

This rapid development of aircraft, coupled with a corresponding increase in passenger, mail and express traffic, presents a maintenance personnel problem of major importance to the operator.

We realize that keeping the transports groomed and in perfect mechanical order requires the services of men who are not only highly trained individuals, but also well grounded in basic principles involved. They need more than mechanical training. In short, with airlines (creating more than \$100,000 for a single transport



airplane, they must have men with an engineering background as well as exceptional mechanical ability. In order that a man may understand the complexity of mechanisms and so be able to properly maintain them, he must be well versed in many subjects other than mechanics. He must be able to reason things out and know why he is doing certain operations a particular way.

The maintenance problem is of such great importance that hundreds of large airlines anticipating delivery of these new planes shortly, have paid many visits to the college to inspect its facilities and to discuss with the faculty the training of maintenance personnel. One of these executives pretty well expressed the opinion of all when he declared: "We can get the airplanes built to our specifications but to get maintenance personnel who are dependable and qualified to service them is a major problem."

Members of our faculty in turn visited practically every airline base and every large aircraft manufacturer in the United States, holding confer-

ences with maintenance and shop superintendents regarding their problems. Only after this careful groundwork had the college assumed the task of providing training for the new field of Maintenance Engineering. It has been found that a course of at least 36 weeks involving 36 classroom, shop and laboratory hours and approximately 15 hours of preparation each week, is necessary for a well-rounded training program for Maintenance Engineers. Seventy per cent of the student's time is spent in shops and laboratory, the remaining 30 per cent being devoted to classroom work. In the Maintenance Engineering shops and laboratories is found equipment closely paralleling that of the large airline maintenance bases. Included in this equipment is the very latest in tools, electrical and instrument repair and testing equipment, blueprinting inspection machines, material and individual bearing testers, sheet metal working machinery, welding apparatus, woodworking machinery; airplane shop equipment, including chaser, milling machine, grinder, drill

presses and lathes. Our engine and propeller department includes steam cleaning tanks, sand blasting equipment, valve grinding tools, hot and hot running in and valve dressing, magnetic test stand, propeller pitch tables, balancing stands, and controllable pitch propellers.

The accompanying drawing shows the location of departments and equipment included in the 1900-sq-ft main shops. Not shown are the five 500-foot shops and building room, the repair test stand, valve dressing building and classrooms used by the Maintenance Engineering School.

The maintenance course is as a graduate of an accredited high school. It comes because he has a definite objective, a career in the maintenance field of aviation. The early part of his training is devoted to the review of high school mathematics and physics, involving 60 hours of classroom work. During his first term (each of the 3 terms is 12 weeks long) the student is also given a course in engineering drawing, which includes free-hand sketching and making and interpreting engineer's drawings. His shop and laboratory work during this term provides 200 hours in advanced metals and applied metallurgy. In this period he acquires both a theoretical and working knowledge of all types of metals used in aircraft construction. The high aluminum alloys, their manipulation and heat treatment, are particularly emphasized. Loft practice is taught one hour each day, but not beyond of evening, hot tools and other keypoint parts being developed.

In the second term the student continues with 60 class hours in mathematics, physics and applied chemistry. The shop and laboratory instruction and practice involve intensive training in the theory of welding and the development of skill in welding tech-

super through the actual welding of sheet, sheet-iron, stainless steel, motted metal and other metals used in aircraft construction. He learns what metals are suitable and what metals are not. He studies the shrinkage, expansion and contraction of metals, jig building, the proper methods of aligning parts before being welded, and other related subjects.

His training in the ever growing low list of instruments and complicated electrical wiring systems gives particular attention and includes numerous study and actual laboratory work in the repair, overhaul and calibration of all flight and engine instruments, including gyro instruments and vacuum pumps. The wiring diagrams of the large transport airplanes are thoroughly studied from actual factory blueprints of these systems, with practical work in complex wiring and trouble shooting on modern airplanes.

Manufacturing, patternmaking and molding, aircraft detailing and up-holding are included in his practical work in the third term. His classroom subjects include industrial engineering, aircraft maintenance, also air transportation history and development, but it is believed the maintenance engineer should appreciate the larger problems faced by the management of the concern by which he is employed.

Engine assembly and alignment, and engine structures and maintenance, are studied both from a theoretical and practical viewpoint. The student is instructed in the solvent features of airplane structures and maintenance and, through practical application, is given the opportunity of aligning and making necessary repairs on airplane structures. He studies control, hydraulic systems and other features incorporated in our present day air transporters. Basic maintenance and operation, including the installation, repair and trouble shooting of radio apparatus, is covered through



four terms of one hour each day, a total of 240 hours. This is of particular value to the student who wishes later to become a flight engineer.

Power plant and accessory overhaul and maintenance come in for 540 hours of classroom and practical shop work. The student is given every opportunity to study the new developments in power plants and accessories. His practical work involves the actual overhaul of power plants, including all of the accessories pertaining thereto. During the time he is studying these subjects, he also receives one hour a day, three days each week, for three terms, in business writing, fundamentals of speech and radioactivity. These subjects are included in order to develop the student's ability to express himself clearly in writing and in speech, in conference and before a group.

Practical, machine shop practice and flight line maintenance come in for a full term of instruction in both theory and practice. The feed back, convertible, variable speed and hydro-mechanical principles are studied and actual work is performed as by the actual maintenance engineer in the shops. Making up of structure and engine parts, and the making and other machine problems are studied and practiced in the

machine shop. Flight line maintenance includes daily practice and complete inspection, engine checks and minor repairs on the feet of 17 flight training planes. In order that he may understand the flight characteristics and have a better appreciation of the importance of his work, and the problems of the men who fly the airplanes, he is given 20 hours of flight instruction and one hour each day for 12 weeks he studies navigation and meteorology.

In the final term the student spends 2 hours a day for 12 weeks in the shop and drafting room, designing maintenance equipment. In this course he is given every opportunity to use his own initiative and develop his own ideas in designing equipment for more accurate and faster maintenance. The very important subject of inspection and safety in the concluding term encompasses the use of the magnifying inspection of engine and other steel parts, high powered magnifying glasses, color testing devices, and inspection reports are made out following complete inspection of parts and also at the engine sightline. Two weeks engine, 4 is believed, must be placed on this subject, as safety in the operation of aircraft depends to a large extent on proper inspection.

In order to meet and his entire course the student is given training in teamwork where he is put in charge of groups of men, with full responsibility for the solving of specific, pointed maintenance problems. Besides serving to refresh the student, or all practical work completed in the preceding terms, this, the period of teamwork training, serves to develop his ability to work with men.

This program of maintenance engineering training, it is expected, will help solve a major maintenance problem by providing for the constant ready replacement, well trained men who, with added experience in the operating field, will probably be able to assume considerable responsibility.

AVIATION'S Maintenance Note Book

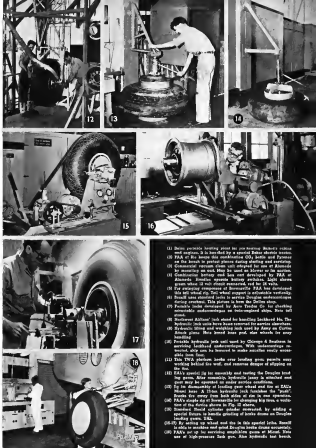


Although it is impossible to put into a reasonable space all the ideas that have been developed to promote safety through good maintenance, we present herewith a selection of shop gadgets and shop practices that seem to involve new and useful ideas. It is our hope that maintenance men in all branches of aviation work will find here something of interest, something helpful to them in carrying out their own jobs.

As a result of our inquiry for maintenance and overhaul pictures the shops responded to such an extent that we have many more pictures available in our files than we could possibly use in this issue. It is our intention, however, to continue the Maintenance Note Book through subsequent issues to put into circulation material that will be of benefit to operators of all classes of aircraft. Acknowledgment is hereby made to the air lines and to the military services for the excellent cooperation which was given us in the preparation of this issue.



APRON SERVICE JACKS, WHEELS, BRAKES



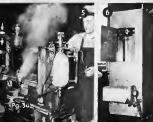
- (1) Shims portable heating plant for pre-heating Babbitt's rollers and castings. It is heated by a special Babbitt electric system.
- (2) FAA of the house this configuration (20) better and Pymore on the bench to perfect plans during shelling and varnishing.
- (3) Construction crew for the new air terminal in the air terminal for mounting on wall. They are used as drawers in the airport.
- (4) Construction drawings and data card developed by FAA at Chicago. Shows various runway vehicles, along with gear wheel (1) and other equipment, red for 18 volts.
- (5) For mounting equipment of Boreville. FAA has designed the air wheel (1) for wheel (1) in automatic control.
- (6) Small unit mounted into the main Douglas undercarriage wing structure. This plane is from the Douglas Corporation.
- (7) Portable jack developed by Aero Tech Co. for checking aircraft undercarriages on telegraphed ships. Run full speed.
- (8) Southwest Airlines' jack stand for handling Lockheed Hs. The hydraulic jack unit has been removed for service elsewhere. Hydraulic stand and working jack used by Aero Tech Co. for checking aircraft undercarriages on telegraphed ships. Run full speed.
- (9) Portable hydraulic jack unit used by Chicago & Southern in servicing Lockheed undercarriages. With undercarriage removed, the unit has been removed to make another ready available (10) from here.
- (10) This TWA machine looks over landing gear, partly for working behind the wheel, and removes danger of slipping on the floor.
- (11) FAA's special jig for quickly and testing the Douglas land gear. After assembly, hydraulic jacks are selected and put into the ground to make service conditions.
- (12) For the disassembly of landing gear wheel and tire in Eagle plane. The FAA has designed this machine for "buddy" service for many from both sides of the air in one operation.
- (13) FAA's simple jig for Boreville for checking lip tips, a modification of the device shown in Fig. 12, allowing for checking lip tips in double grinding of knots down on Douglas landing gear. TWA.
- (14) By setting up wheel and tire in this special table, Boreville is able to examine the wheel for any defects (15) from the FAA.
- (15) FAA's set up for servicing complete gear at Mount. This set of high-pressure jack gear. Also hydraulic test bench.

AIRPLANE OVERHAUL

(1) Satisfactory repair and refueling department, U.S. Navy.

(2) Encapsulating and upholstery repair, PMA, Miami.

(3) Repair before various elements are used by United for rig and upholstery cleaning at Chryson.



(4) New United uses its fiber hair to handle wing panels.

(5) Another test airplane heating system before and after release in this set-up.

(6) Cabinet developed by Empire for testing airplane heating and ventilation system.

(7) Wing bending fixture as used in U.S. Navy repair station. Wing panels may be heated even.

(8) Square drive, PMA, Miami.

(9) Special bond was used in assembling cockpits in wing ribs assembly.

(10) Gaps used in winging hole locations for accurate impact sheet metal shop, PMA Chicago.

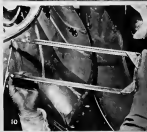
(11) Tabled portable electric and compressed air system.

(12) Portable cable welding bench and work stand as developed by Lockheed Air Lines.

(13) Fixture developed by U.S. Navy to speed engine mounting legs.

(14) A pair of 20-in. steel winging rollers takes care of United's winging sheet requirements for plane over haul.

(15) A Sun American tank repair shop.





WORK STANDS



- (1) Complete workshop on wheels, just one-half of the work stand for the Atlantic type Boeing Clipper, FAA.
- (2) Truss on the FAA work stand for the Boeing Clipper.
- (3) Platform for servicing and work, FAA Atlantic type Clipper.
- (4) Ladder type stand in use at Miami base, FAA for S-42 wet servicing.
- (5) For wing work on FAA S 54th Miami.
- (6) Brownsville (FAA) developed this type of stand for Douglas and Lockheed.
- (7) Baker's version of a tall group servicing stand.
- (8) TWA light engine servicing stand at Newark.
- (9) TWA main servicing stand, Kansas City.
- (10) A group of work, marked out servicing platforms in use in Rand's Dallas shops.
- (11) Bridge-like scaffolding for fuselage cleaning, GAC.
- (12) U.S. Army's hold maintenance shelter for outdoor work in cold weather.
- (13) Field maintenance shelter in place on Army S-1B Bessies.
- (14) A portable hydraulic maintenance stand for large airplanes developed by the U.S. Army.

HANDLING



ENGINES AND PROPELLERS



(1) Complete power plant is hoisted on dolly and moved. PAA, Miami.

(2) Self-mounted hoist for handling power plants on the PAA Tanager Clippers.

(3) Penn-Carlisle engine hoist is also used to transport engines over rough ground between ship and hangar.

(4) Engine moved stand for Boeing Clippers. PAA, Baltimore.

(5) Dolly for handling engine-propellers onto boat. Boeing Clippers. PAA, Baltimore.

(6) Northwest Air Lines "powercrack" engine assembly stand.

(7) Self-mounted engine in and out of overhead shops with this special Baker electric hoist truck.

(8) Delco-Ram engine (in stand, double rotation type. PAA, Tacoma Island.

(9) Stand for propeller installation. PAA, Brunswick.

(10) Eastern Air Lines hoist and work stand for propeller installation.

(11) Propeller cart by Northwest Air Lines. St. Paul.

(12) PAA's propeller cart at Emma's Clip.

(13) Bakewell's propeller governor control test unit which measures the amount of oil pumped by the governor at various speeds for a period of one minute. TWA, Emma's Clip.

(14) Special propeller wrench. PAA, Miami.

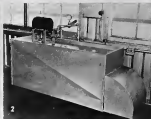
(15) Test bench and special equipment developed by United for servicing Supermarine propellers.

(16) Stand for holding and polishing propeller blades. PAA, Brunswick.

(17) Eastern Air Lines setup for checking amount of oil pumped by propeller governor.



ENGINE OVERHAUL



- (1) Ultrafine apparatus for cleaning shafts and all out of all kinds by forced circulation of cleaning fluid.
- (2) Oil cooling cleaning and test bench set up by Pen America at Miami.
- (3) Dated close two all reduction of a time, test facility with output transmittance for one or two hours, followed by Tens Friction solution, with fluid cleaning by steam and steam spray.
- (4) Mid-Chiefdom test a Rensar test pump to determine friction through oil reduction in cleaning.
- (5 and 6) A close portable cleaning tank built by a gasoline burner discharging into a submerged tube system. (Clockwise) Fuel tank and burner unit. (Below) Pen view showing heating coils developed by Rensar-Motors.
- (7) Pen-America of Miami handles cylinders in the convenient daily.
- (8) Automatic compressed air cylinder and piston ring lapping machine recently developed by United at Channahon.
- (9) A sliding cylinder lapping device built by Southwest Air Lines.
- (10) IPR's cylinder vice.
- (11) Valve guide stress setup at Pen America's Kew-Ford shop.
- (12) PRA type cylinder vice (Chromalox).
- (13) ECL checks mechanical alignment. Bush assembly is placed in ball bearing balls and leveling air takes on surface gaps, light.
- (14) American Air Lines uses this fixture and ball to top of seal rings on engine superchargers.
- (15) American uses this simple magnetic ramping device to check and give parts for cracked inspection.
- (16) The Royal Air Reserve Base at Floyd Bennett Field has developed this special rack, to hold 24 complete parts for a 14-cylinder engine.
- (17) Eastern Air Lines' equipment for checking carburetor test bench.
- (18) By using a torque-inducing device, American is tested engine test tightness.
- (19) United's frequent bench for checking carburetor characteristics after overhaul.
- (20) Automatic air intake control test bench, Southwest Air Lines.
- (21) Eastern's automatic carburetor and mixture control test stand.





ELECTRICAL AND RADIO



- (7) Rag for assembling various systems because no developed by (TWA)
- (8) TAI: used the best printing discussed; various printing are assembled on matter sheet are installed against empty paper (TWA)
- (9) Test bench and 10 to 15-disc magnetic tape (TWA)
- (10) Space Plug evolved from (TWA)
- (11) Space Plug evolved from (TWA)
- (12) Space Plug evolved from (TWA)
- (13) Space Plug evolved from (TWA)
- (14) Space Plug evolved from (TWA)
- (15) Space Plug evolved from (TWA)
- (16) Space Plug evolved from (TWA)
- (17) Space Plug evolved from (TWA)
- (18) Space Plug evolved from (TWA)
- (19) Space Plug evolved from (TWA)
- (20) Space Plug evolved from (TWA)
- (21) Space Plug evolved from (TWA)
- (22) Space Plug evolved from (TWA)
- (23) Space Plug evolved from (TWA)
- (24) Space Plug evolved from (TWA)
- (25) Space Plug evolved from (TWA)
- (26) Space Plug evolved from (TWA)
- (27) Space Plug evolved from (TWA)
- (28) Space Plug evolved from (TWA)
- (29) Space Plug evolved from (TWA)
- (30) Space Plug evolved from (TWA)
- (31) Space Plug evolved from (TWA)
- (32) Space Plug evolved from (TWA)
- (33) Space Plug evolved from (TWA)
- (34) Space Plug evolved from (TWA)
- (35) Space Plug evolved from (TWA)
- (36) Space Plug evolved from (TWA)
- (37) Space Plug evolved from (TWA)
- (38) Space Plug evolved from (TWA)
- (39) Space Plug evolved from (TWA)
- (40) Space Plug evolved from (TWA)
- (41) Space Plug evolved from (TWA)
- (42) Space Plug evolved from (TWA)
- (43) Space Plug evolved from (TWA)
- (44) Space Plug evolved from (TWA)
- (45) Space Plug evolved from (TWA)
- (46) Space Plug evolved from (TWA)
- (47) Space Plug evolved from (TWA)
- (48) Space Plug evolved from (TWA)
- (49) Space Plug evolved from (TWA)
- (50) Space Plug evolved from (TWA)
- (51) Space Plug evolved from (TWA)
- (52) Space Plug evolved from (TWA)
- (53) Space Plug evolved from (TWA)
- (54) Space Plug evolved from (TWA)
- (55) Space Plug evolved from (TWA)
- (56) Space Plug evolved from (TWA)
- (57) Space Plug evolved from (TWA)
- (58) Space Plug evolved from (TWA)
- (59) Space Plug evolved from (TWA)
- (60) Space Plug evolved from (TWA)
- (61) Space Plug evolved from (TWA)
- (62) Space Plug evolved from (TWA)
- (63) Space Plug evolved from (TWA)
- (64) Space Plug evolved from (TWA)
- (65) Space Plug evolved from (TWA)
- (66) Space Plug evolved from (TWA)
- (67) Space Plug evolved from (TWA)
- (68) Space Plug evolved from (TWA)
- (69) Space Plug evolved from (TWA)
- (70) Space Plug evolved from (TWA)
- (71) Space Plug evolved from (TWA)
- (72) Space Plug evolved from (TWA)
- (73) Space Plug evolved from (TWA)
- (74) Space Plug evolved from (TWA)
- (75) Space Plug evolved from (TWA)
- (76) Space Plug evolved from (TWA)
- (77) Space Plug evolved from (TWA)
- (78) Space Plug evolved from (TWA)
- (79) Space Plug evolved from (TWA)
- (80) Space Plug evolved from (TWA)
- (81) Space Plug evolved from (TWA)
- (82) Space Plug evolved from (TWA)
- (83) Space Plug evolved from (TWA)
- (84) Space Plug evolved from (TWA)
- (85) Space Plug evolved from (TWA)
- (86) Space Plug evolved from (TWA)
- (87) Space Plug evolved from (TWA)
- (88) Space Plug evolved from (TWA)
- (89) Space Plug evolved from (TWA)
- (90) Space Plug evolved from (TWA)
- (91) Space Plug evolved from (TWA)
- (92) Space Plug evolved from (TWA)
- (93) Space Plug evolved from (TWA)
- (94) Space Plug evolved from (TWA)
- (95) Space Plug evolved from (TWA)
- (96) Space Plug evolved from (TWA)
- (97) Space Plug evolved from (TWA)
- (98) Space Plug evolved from (TWA)
- (99) Space Plug evolved from (TWA)
- (100) Space Plug evolved from (TWA)



INSTRUMENTS

- (1) Special die for testing Sperry wire spools. Coilset at left contains vacuum pump. Universal swing stand at right, FAA, Miami.
- (2) All electrically operated light instruments may be checked on this electrical test panel, FAA, Miami.
- (3) Galvania oil-filled pressure chamber for testing aerospace cables and bellows as well as calibration of clock indicators. At Cleryville (5000 ft. a.s.l.) it is necessary to use pressure to lower the chamber to sea level conditions.
- (4) Standard low developed standard test panels for oil stream instruments. In racks, left to right—viscometer test stand, pressure gauges test (20 to 5000 ft. per min.), low pressure and vacuum gauges. Necessary wiring and wiring are permanently installed.
- (5) FAA's portable test equipment of the low side. In check instruments (left) and other vacuum-driven instruments without running equipment. Right, in check electrical instruments without batteries or sufficient running material, or to check control line operations without using equipment.
- (6) Hydroscopically-driven Sperry Gyro pilot test equipment. The unit can be adjusted to any roll, yaw, or pitch with one lever on the front, FAA, Traverse AFB.
- (7) Test bench for calibrating thermocouple gauges. Levels potentiometer used for calibrating (right). Small electrically heated oven watched in rear of table for heating thermocouples.
- (8) Instruments for checking ball bearings used in Sperry instruments. Draw and measure dimensions but select balls at uniform size and measure by comparing between quality optical flats, GAO.
- (9) Portable test table for calibrating high pressure gauges on Douglas loading gear system, FAA, DCA.
- (10) Mid-continent's adjustable bench for checking Sperry deadweight gauges. Support slotted in a test cabinet mount.
- (11) Inflatable test stand for checking operations of deadweight cells, FAA, DCA.
- (12) A bench unit for testing wire instruments and instrument parts as developed by Pan-American in DCA.
- (13) Test stand for tape and bulk indicators. Note manometer located on inside table which permits continuous loading in either direction without releasing the rubber tube. This also further down.
- (14) Control of Sperry's electrical instrument checkout department showing test stand for Cambridge analyzer in Indianapolis.



HYDRAULIC SYSTEMS



- (1) Free American Hydraulic Test Bench as installed at Penn State's controls hydraulic test unit. A Douglas loading gate used under test.
- (2) USA's secondary hydraulic test bench. An automatic system controls hydraulic fluid flow from tank to pump. Rate tests flow from tank to tank by gravity. Capacity up to 12,000 lb. per sq. in.
- (3) All Douglas operating and control units are checked on this USA bench.
- (4) USA's portable bench is fit with test bench, speed control, pressure indicator.
- (5) Checking Decker pumps, valves, etc. in USA's Gray test shop.
- (6) USA's portable hydraulic test bench is checking equipment in operation.
- (7) USA's portable bench is fit for checking SC3 by double system without running motor.



MAINTENANCE In Non-Scheduled Operation



BETWEEN the maintenance hours of the scheduled services there is a group of highly efficient repair men whose function it is to care for the thousands of private owners and miscellaneous agencies whose flying hours reach astronomical totals yearly. These hours range from ships comparable in operation and equipment to those of the larger airlines down to the one-man plane where a single aviator keeps a log of his own flying and a single mechanic keeps a log of his own work. Some where along the line is the mechanic's shop where overhaul work is done by staffs under the guidance of licensed mechanics.

But you can't judge the size of a shop by the size of floor space or the

number of tools visible in the related eye. Some of these that were doing the best jobs look only slightly larger than a couple of telephone booths and almost as devoid of equipment. Yet closer examination reveals the real equipment hiding places for tools and gauges and enough tools for almost every piece of equipment.

Whether an operator is set up to do work in aerial operations or later a single engine flying over all kinds, one of the important things to have is that service levels. And there is no better proof than the experience of progressive Bell Helicopters who report that 100,000 miles have been flying and no rebuilding each year since the first Bell Helicopter



1. In Bell Helicopter Aircraft is shown in the air.
2. Al Hooten (Curry Wright Test) machine is shown in the air.
3. Arthur E. Tracy, Frank Day, J. O. Brown (Bell Helicopter).
4. Bell Helicopter, who have service levels.
5. Small model department of Bell Helicopter.
6. The could not all the Bell of Bell Helicopter a shop at Bell Helicopter.
7. Portable high pressure air tank for testing Bell Helicopter in the Bell Helicopter Aircraft.
8. Bell Helicopter, who have service levels.

an airplane here and spend only at 150¢. Belonging to the group of basic tools that run on air/oxygen work, Bosch-Hausag occupies a 25,000 sq. ft. hangar on Love Field and goes as far as to provide a list of retail places for the use of customers, whose shops are in the shop.

Examples of the many tools devised in the Bosch-Hausag shops are the engine mounting plate and the engine parts rack covers. The mounting plates are heavy steel steel tools, each with plate being designed to carry a particular model engine. All of these plates attach in identical manner to the reusable engine disassembly stand, so the mounting and handling of engines during disassembly and assembly is greatly simplified. The engine parts rack covers are unique to the shop, as all other shops rely upon making the parts in various dry or the shop at the Bosch-Hausag base, but in order to assure maximum reliability of all parts during the period that the engine is disassembled, special air/oxygen, quick detachable access covers are provided to enclose the engine parts racks when they are not actively in use. An example of a large maintenance base that grew out of a supply house

is Pacific Aerospace Corporation which is now an aircraft supply, service, maintenance, and aircraft storage base, approved by the CAA for every class of aircraft, engine, propeller, airframe, and radio work. In addition to its heavy business among private and non-scheduled aircraft operators, Pacific Aerospace is under contract to maintain all of the engines operated by Western Air Express, and also does all engine overhaul for the Pacific Coast Division of the U. S. Coast Guard, and Coast Guard aircraft overhaul under special contract. From a small area building the Pacific Aerospace plant has grown to its present dimensions of approximately 45,000 sq. ft. of floor

space. Peak volume of business in that has been \$750,000 in one year. Approximately 100 employees are now on the Pacific Aerospace payroll in connection with maintenance work.

Two other service links have been developed at the Redwood Airframe Corporation repair station in Kanas City, Mo., both involving adaptation of "jerk" equipment to a highly useful purpose at low cost, the cost of doing that can be done with a little ingenuity around any airport. Finding that there were a good many calls for supplying high pressure air to stretch out on the line or security on the field, Redwood's service staff converted an air storage tank on a pair of old nose wheels, equipped it

10—Main overhauling a piston in the Bosch-Hausag Shop.

11—Twin mounting rack arrangement in the shop at Santa Wagon Truck.

12—Bosch W. Bosch Collision Repair' patented equipment in shop repair job.

13—Bosch-Hausag tools in the Redwood base of Pacific Aerospace Corp.

14—A corner of the tool room in the Santa Wagon Truck shop.

15—Pacific Aerospace has a complete tool house.



16—Tireless engine bed stand in approved repair station at Santa Wagon Truck.

17—Steel steel plates developed by Bosch-Hausag for engine disassembly.

18—Cover covers for engine test drive racks protect parts from dust in Bosch-Hausag shop.

19—Pacific Aerospace equipment for mechanical maintenance developed by Chuck Foley.

20—A two-thirds series to engine disassembly line is installed by Chuck Foley in this workshop base.

21—Golden approved engine test stand used by Pacific Aerospace.

22—An engine cover developed in the engine shop at the Santa Wagon Truck.

23—A separate building houses the gas plant shop at Pacific Aerospace.

24—Friedrichs shop center developed by Redwood Air Service.



with a suitable length of air hose and then pumped up the tank in the hangar. Another idea that has paid dividends was conversion of an old Ford chassis to a close coupled "jack-roller" dolly truck and repair service truck. This "jack-roller", equipped with a special low gear ratio, has proved ideal for handling transports around the field and in and out of hangars. A special dolly was developed to get under the end of nos-

of the modern transports, and carry the tail wheels.

Colliers "Fingers" Inc. operates a fleet of fifteen airplanes in connection with flight instruction work in the school. Therefore the school has found it profitable to obtain approved repair station rating in order to maintain all its own shop equipment

This plan also provides steel work material for the mechanical students enrolled in the school. When work is hard, portable engine repair jobs are maintained in order to keep the shops busy at all times with maintenance.

In connection with training hundreds of students in aircraft and (Time to Page 61)



Spot welded aluminum alloy construction gives a sleek appearance to the Youth-Sikorsky

Spot Welded Airplane

New Type of Aluminum Alloy Fabrication Used in Vought-Sikorsky

The pioneering work by Vought in spot welded aluminum alloy construction is now being applied to the manufacture of the Model XG52U-1 scout observation monoplane now under production for the Navy at the Vought-Sikorsky plant at Stratford, Conn. This type of structure not only simplifies fabrication but pro-

vides the smooth surface so much desired for improved performance at low speeds. The XG52U-1 is a full cantilever, low wing type with all-metal monocoque fuselage. Power plant is the nine-cylinder Pratt & Whitney Wasp Junior engine having a take-off rating of 440 hp. The plane is a standard, two Model constant speed type. Although it is available as a biplane, it is designed primarily as a single that requires no operation from landing or carrier catapults. Provision is made for a crew of two and the ship is chiefly intended to direct gun fire and lay long range observation aiming mission. The monocoque type affords improved vision for the crew as well as performance exceeding that of the higher powered biplane previously used and retains the desirable landing characteristics of the biplane type.

Overall span is 36 ft., length, 38 ft., 10 in. (tailplane) and 30 ft., 1 in. (fuselage). Gross weight is 4700 lb. (empty) and 4950 lb. (loaded). Performance figures are not yet released. At the time of writing the ship has had more than 200 hr. of test flying. The Navy contract for this type represents \$2,500,000.

the cockpit encloses the lateral control in low speeds.

The XG52U-1 is a full cantilever, low wing type with all-metal monocoque fuselage. Power plant is the nine-cylinder Pratt & Whitney Wasp Junior engine having a take-off rating of 440 hp. The plane is a standard, two Model constant speed type. Although it is available as a biplane, it is designed primarily as a single that requires no operation from landing or carrier catapults. Provision is made for a crew of two and the ship is chiefly intended to direct gun fire and lay long range observation aiming mission. The monocoque type affords improved vision for the crew as well as performance exceeding that of the higher powered biplane previously used and retains the desirable landing characteristics of the biplane type.

Overall span is 36 ft., length, 38 ft., 10 in. (tailplane) and 30 ft., 1 in. (fuselage). Gross weight is 4700 lb. (empty) and 4950 lb. (loaded). Performance figures are not yet released. At the time of writing the ship has had more than 200 hr. of test flying. The Navy contract for this type represents \$2,500,000.

Overall span is 36 ft., length, 38 ft., 10 in. (tailplane) and 30 ft., 1 in. (fuselage). Gross weight is 4700 lb. (empty) and 4950 lb. (loaded). Performance figures are not yet released. At the time of writing the ship has had more than 200 hr. of test flying. The Navy contract for this type represents \$2,500,000.



Star and left wing showing floor attachment

AVIATION
July 1935
15

Fairchild Trainer

Low Wing Tandem Monoplane has 6-cylinder, 385 hp. Ranger.

A new five monoplane trainer with steel tube fuselage and all-metal wing has just been completed in the Fairchild Aviation Corp. Power plant is the Ranger 6-4188 2A, inverted engine rated 365 hp. at 2450 r.p.m. Designed to Air Corps requirements, the Model Model was constructed in a low-wing type to simplify the transition from biplane to all-metal monoplane.

Mainstream and structural advantages of plywood construction with plywood ribs destined to use for wing covering. The basic structure of the wing is conventional, using spruce and plywood. Fixed inter-carrier tail surfaces are similar to the wing in construction. Welded



The wide wheel landing gear and tips of the Fairchild Model XG52U-1

chrome molybdenum steel tubing is used in fuselage with its internal engine mount and in the radial construction. The structure is built up of sheet steel ribs riveted to a composite tube.

Automatically the wing has a tapered plan form using the NACA 2415 section at the root and the 4400 section at the tip. Leading edge dorsal, NACA type aluminum alloy, tips are used. Ailerons are automatically balanced. Their structure is of aluminum alloy, three corner.

Vertical landing gear struts are fixed with oil and spring shock absorbers having 3 in. of travel. Shock absorbers are accessible from both inside and 31 in. pressure wheels are used. The tail wheel is mounted on an axle and is swiveling through the left range of



rudder travel. An engine rudder position, the wheel is released automatically to control.

Yacht engine is covered by a sliding cowling of Plexiglas or an alternate spot cockpit arrangement is available. Seats are adjustable vertically and accommodate two pack parachutes. Dual controls in the front cockpit are removable.

Instrument panel, air rubber mounted and standard equipment includes compass, fuel gage, two air-speed indicators, girth tube diameter of thermometers, barometer oil and fuel pressure gages. Space is provided for engine hood flying equipment after engine lighting is a Fairchild Monoplane may be provided.

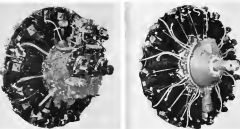
Fuel supply is carried in two 20 gal. wing tanks in the wing panels and 30 gal. of oil are carried in a welded aluminum tank mounted in the front side of the fuselage. An engine driven oil pump and an emergency whistle pump are used in the ground system. The exhaust manifold is a tapered collector attached to each port in series of ducts and passing through a cooling tunnel in the lower cowling.

Specifications furnished by the manufacturer are as follows:

Wing Span	36 ft.
Wing Length	38 ft.
Overall Length	38 ft.
Wing Area	270 sq. ft.
Wing Loading	144 lb./sq. ft.
Crew Weight	1000 lb.



AVIATION
July 1935
16



G-200 Cyclone

Wright Resumes Release for Export of 1,800 hp Engine

DOWNTOWN NEW ORLEANS was the scene of the first test of Wright Cyclone development. The R-1890-B of 1912 was rated at 575 hp (the G-200, now released for export, has a take-off rating of 1,200 hp at 2,800 rpm). For protected sea-level operation the engine, equipped with two-coupled superchargers, is rated 1,000 hp at sea level, 1,000 hp at 4,000 ft., and 950 hp at 14,000 ft., in the G-203 model. The G-200 has an identical side-off rating at sea level and carries the 1,000 hp rating for protected periods at sea level up to 4,500 ft. Cruiseable speed for protected ratings is 3,000 rpm. The single row G-200 has a liner of 6.125 in. stroke of 6.035 in. and compression ratio of 6.7 to 1. It is available in a ground engine with propeller speed reduction ratio of either 4.8 or 16.9. Dry weight is 1,302 lb. or about 1.05 lb. per hp.

Cyclones are made in three of the G-200 series but they are closer and denser on barrels and heads. New valve ports, valves and coils, new and increased shrink and form. In the new for head attachment are features: intake pipes and exhaust ports have larger size. The steel exhaust valve seat is of new design and a steel intake valve seat replaces the brass type on previous models. Bore-to-bore height has been increased slightly to provide clearance in the

rod and arm left sides but covers have been modified so as not to increase the engine diameter. Covers have integral cast ribs for better attachment. Two axles are provided on the front of each exhaust support box for the cooling. Twenty ball-down supports hold the cylinder in the cradle.

Magnesium alloy is now used for the magneto base section which houses the retractor gear and has been modified to provide for the vertical mounting of the constant speed propeller governor which is now driven through level gears from the cam intermediate gear.

The cooling system which is now closed loop on aluminum alloy casing, has been redesigned for stronger attachment to the new main crankshaft using long expansion joints of stainless steel. New holes have been made in the casing for the use of radial reversal of tangential, intake pipes. Mounting rods and clamping are the same as on the G-180 Cyclone.

The new crankcase, consisting of two halves bolted together in the center of the cylinders, is of steel in the G-180 but is aluminum modified. The two halves are now bolted together internally and an internal flange is provided for the attachment of the base section. This flange also acts as the support of the main shaft in the web of the main crank case providing greater strength in

this form as all remaining shafts which supports the remaining crank arms of the engine. The front and rear main shaft bearings are larger and no supports or shims are used. The bearing inside diameter is steel sleeve, shrink into the crankcase.

The supercharger rear bearing is mounted close a magnesium alloy casing and assembled with a new cap and diffuser. Inlet passages have been enlarged and strengthened and the roller-bearing adapter has been modified toward the rear and has been redesigned for greater flow capacity. Rear intake gears are modified the same as on the G-180 Cyclone. An automatic oil filter is included in the supercharger rear bearing and the new standard Air Corps approved oil filter drive fast pump mount is provided.

The supercharger rear housing cover is also modified from a magnesium alloy casing. A revised version (See page 90).



The Dynamic Design is used in the new model.

Porterfield-Turner 50

48 and 75 hp. Models and a Trainer soon to be available.



Porterfield-Turner 50 in flight (left). From the above view, the engine and landing gear (below).



New machinery and personnel is being added to the facilities of the Porterfield-Turner 50. The latest model in the line, 48 and 75 hp. engines are being test flown and a 2-place trainer is now under construction.

The Model 50 is a high wing, open monoplane built with two 180 inch interval of the rear type or strut bracing. Wing span and rib are as square with end ribs, dual leading edge, and lower covering. Airframe area is 15% of the total wing area. Dihedral has been increased to improve lateral stability. Trimming tabs are controlled from either side by a lock. Fuselage construction is conventional and the welded steel tube tail group is very broad. Landing gear has a 60° strut.

The engine mounting system is altered through a larger door, 40 in. wide 18 in. high. It is completely upholstered in synthetic grass, leather with upholstered parachute seats. Most of the instrument panel is in 11 inches of the fuselage. Behind the rear seat, is the turbo-back flange in the fuselage compartment 24 in. by 30 in. by 12 in. which accommodates 30 lb. of baggage.

Engine mounts include dual stick controls and brakes, and non-plastic reinforcement board, suitable from either

front or rear seat. Large Pyralis windows furnish excellent vision.

Power plant is the Continental 50 hp. engine having a fuel consumption of 3.25 gal. per hr.



Chief Goes Seaplane

65 hp. Anasoa Now Available on Floats

FOLLOWING last year's trend in seaplane development, the Anasoa seaplane has been approved as new Anasoa "Chief" 65 hp. and 100 hp. models. The two models are identical in construction, except for the difference of 35 hp. in the engine, and they are nearly identical in performance, cruising speed of the 100 hp. model being listed at 55 mph and of the 65 hp. model 50 mph.

Following the same basic principles of design and construction as the present 50 hp. series, the 65 hp. "Chief" differs chiefly in provision for mounting in the new 65 hp. Continental engine. Like previous models the 65 hp. "Chief" is a wide-body

two place monoplane with 1100 in. wheel height. The fuselage has a gross weight of 1525 lb. and a useful load of 440 lb., while the seaplane has a gross weight of 1255 lb. and a useful load of 412 lb. Considering the fact that the two new models in the current performance stand through use of greater horsepower and the application of improved strengthening techniques, the new models are the most powerful seaplanes yet in the market.

	Chief 65 hp.	Chief 100 hp.
Top speed	55 mph	50 mph
Cruising speed	50 mph	45 mph
Stalling speed	25 mph	25 mph
Rate of climb	400 ft.	300 ft.
Service ceiling	14,000 ft.	11,000 ft.

CONTINENTAL



CONTINENTAL AIR LINES at Denver Municipal Airport, being serviced by further Texaco Truck. Nothing but Texaco is used in Continental shops.



NEW TEXACO

AVIATION
July 1938
81

EXTENDS SERVICE TO WICHITA



G. H. HUNTER, Vice President Operations, Continental Air Lines

KNOwn EVERYWHERE as operators of America's fastest airline, Continental adds to its mileage ... and prestige ... by inaugurating an new East-West service between Pueblo and Wichita.

Continental Air Lines brings Denver and the Rocky Mountain country within three hours' flight of Wichita.

Continental uses nothing but New Texaco Airplane Oil and Texaco Aviation Gasoline.

More scheduled airline mileage is flown with New Texaco Airplane Oil than with any other brand.

Skilled aviation engineering service is available to the aviation industry at all times. To get it, phone the nearest of 2229 Texaco warehouses or write:

The Texas Company, Aviation Division, 135 East 42nd Street, New York City, N. Y.



ALVIN K. SMITH, Sup. of Maintenance, Continental Air Lines. Mr. Smith played a part in assembling the famous NC-1 across back in 1915. Also did research, development and engineering work on DC-4.

AIRPLANE OIL

AVIATION
July 1938
83

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

A particularly versatile deep-drawing press has been developed by the Hydraulic Press Mfg. Co., of Mount Lebanon, Ohio. Featuring "auto-tight" rollers, and "Pressure" action, the new H-P-M press has all piping, wiring, and control bridges concealed and all control drums and gauges fully mounted. The press embodies three separate hydraulic actions for operating respectively, the main draw punch, the blankholder ring, and the bottom of the regulation triple action drawing die. An important feature is the ability to vary the pressure at each of the four stations of the blankholder, allowing the blank to be held more tightly at some points than at others for the drawing of difficult and irregular shapes.—*Aviation*, July, 1939.

Designed for strength maintenance work a line of socket wrench sets is offered by the J. B. Williams & Co., New York, covering rates from 1/2 in. to 1 1/2 in. with special attachments, drivers, and universal joints. Each set is supplied in a strong steel case.—*Aviation*, July, 1939.

High altitudes will not "hog" the stoppers in rapid counters packed in the new straight stemless alloy leveling sets manufactured by the Macho Division of Erie P. Machinery, Inc. All models are steel with rubber and pistons to prevent counts from entering and dirt. The stamped shells are heat treated to provide strength and finished in a special aluminum finish. Features of women's tools are done in silk with removable drive levers, meters and built-in pistons, and upper-drawing jewelry pockets.—*Aviation*, July, 1939.

As aircraft factories continue to expand in size the need for parts handling trucks of special design becomes greater. Such a truck, of particular interest to aircraft manufacturers because of its small size and extreme maneuverability, is the "Saddle" gasoline powered dock type truck built in capacities of 2000, 3000, and 3500 lb. by the Clark Tractor Division of Clark Equipment Co., Burke Creek, N.Y. The truck has a wheelbase of 36 in. and a turning radius of 47 in., whereas that of an ordinary truck is an interesting 14 ft. 6 in. wide. The truck has a towing height of 50 in. and the overall height of the machine is approximately 90 in., including the driver who sits up at the center of the machine with perfect vision in all directions.—*Aviation*, July, 1939.

A new type convertible spot welder recently designed for welding stainless steel and titanium rods is used in the aircraft industry, has been developed in the Ryan Aircraft Company Factory, San Diego, Calif. Known as the model 106, the welder is manufactured by Joseph S. Tucker, Barnes Machine Company, Los Angeles. The machine has a rated draw at 30 in. and a force between the arms of from 4 to 18 in. Welding pressure is two shots of 125,000 lb. At set in radius shaft, right, left, or right speed, control the machine in a same welder.—*Aviation*, July, 1939.

A welcome machine tool innovation designed primarily for aircraft production work is offered by the First Machine, Inc., of Glendale, Calif. The new tool is divided as a milling machine attachment, as it is applied on horizontal and not immediately converts any horizontal mill into a full universal. Made in two types, it is offered with or without a 4 in. specific travel. It is claimed that any milling machine operator can use this attachment without special training.—*Aviation*, July, 1939.

The new Weldmaster offered by General Communication Company, Boston, Mass., seems like a solid last judgment, because it offers, also, a satisfactory replacement for carrying missiles, wiring, heating, lighting and measuring features. As a trade from an air to a home customer the Weldmaster also tells



RFM Triple Action Press



Weldmaster Case



Clark 'Buddy'



Convertible Spot Welder



Workless



2014 Tool Set

accurately the speed and direction of the wind, model A measuring velocities of 5 to 30 m.p.h., and model B speeds of 10 to 40 m.p.h. We believe this should prove of real value to gliding and soaring groups, and will have many applications in other fields of aviation. The unit is light and compact, total weight being less than two ounces, and the price is approximately two.—*Aviation*, July, 1939.

Looking somewhat like a Chinese puzzle the Uni-A-Tool kit is offered by Tempco, Kew-Forest, of Chicago, as the solution to a thousand and one puzzling problems, small parts and large. Among the more possible applications are: clamping or pulling together structural members or any movable objects within an inch capacity, pushing, holding, lifting, lowering, clamping, bending, and loosening. The Uni-A-Tool also removes gears, wheels, pulleys, and propellers. Five sizes are available, each in a compact metal box complete with maintenance. The set includes: separate jaws, clamps, chains and springs for use with a special mechanical jack that operates either in tension or compression.—*Aviation*, July, 1939.

As tooling continues to play a relatively more important part in the production of metal aircraft the development of tool and die making machinery has become vital to production of commercial aircraft production material. A particularly interesting machine for such work is the Black-Metal-Tool and the machine machine, patented by the Black-Metal-Tool Company, Chicago, Ill. This machine serves also as a sheet iron production machine for quick set ups. Operations for which it is designed include: hot forming, vertical and horizontal rolling, corner rolling, drawing, flanging, drilling, grinding, bending, and sawing. Changes from one attachment to another are easily made by one man.—*Aviation*, July, 1939.

Designed to solve the many maintenance problems involving applications of more than normal manpower in pulling, pushing, clamping, spreading, and bending operations, the "Turn-Over" hydraulic jack device has been developed by the Black-Metal-Tool Co. of Milwaukee, Wis. The equipment consists of a 10-ton capacity controlled hydraulic unit, special attachments, and a pump, all mounted on a portable stand that can be rolled anywhere in the shop or hangar. The hydraulic unit consists of a hand-operated pump separated from the rest by a shock high pressure hose, enabling the rest to be operated in any direction. The pump is sufficiently wide to maintain both hydraulic units available to convert the size and shape of the lifting a very wide plant, and other conditions of the equipment are readily made to fit the requirements of any job.—*Aviation*, July, 1939.

In keeping with the maintenance theme of this issue of *Aviation*, we are pleased to state a strong flavor of maintenance items among the many current trade products which have come to our attention, and of which we offer the following for your consideration. Please write direct to the firms listed:

AMERICAN STANDARD FLEXIBLE METAL TUNING—A 24-page illustrated manual and catalog of flexible tuning available for aircraft replacement. The American Iron Co., Worcester, Mass.

THE PRINCIPLES OF VALUE RECONSTRUCTION—An available reference work for the maintenance shop, dealing with value measurement in 22 parts of well illustrated and completely practical value cost maintenance information. The Black & Decker Mfg. Co., Towson, Md.

ENGINE AIRCRAFT SPECIALIZATION—A 24-page illustrated manual of the complete list of engine aircraft specialties, which consists of overhaul, speed rings, delivery, overhaul, spacers, wheels, and many other special items accumulated from sheet metal or steel alloys. Engine Aircraft Specialists, Kansas City, Mo.

FALCON BOLT AND BOLTER BROTHERS INC. AIRCRAFT—An 8-page illustrated folder containing tables of dimensions and load capacities of Falcon bolts and other information of special interest to aircraft designers and maintenance men. The Falcon Bolting Co., New Britain, Conn.

FRANK-KALON SOCIETY GLOW LIGHTING BOMB CHART—This interesting device is a circular reference chart giving full information on diameter, length and depth per inch of a wide range of rocket gun, aircraft, jet engines, and various hand driven bolts. Frank-Kalon Corporation, 200 Varick St., New York 13, N. Y.



Lycoming 65

Manufacturer rates engine approved for 75 hp at lower output for the present.

Construction and design details of the Lycoming Model 65-145-B engine, announced in Avionics for June, 1959, are now released by the Aviation Manufacturing Co. Although it is rated at 65 hp (2600 r.p.m.) the new engine develops 75 hp at 3100 r.p.m. The 75 hp rating is approved under A.T.C. No. 256. Cranking power of 47 hp is available at 2300 r.p.m. using 75 cc. fuel. Weight with single ignition is 155 lb. Fuel consumption is 34 gals. per hr. at full throttle and 29 gals. per hr. at cruising.

The internal crankcase and cylinder block is split vertically through the center with a ground metal to seal joint and bolted together with through bolts in the 50 hp version. Four cooling bosses with cast integral with the crankcase sections providing a platform type mounting. Main and connecting rod bearings are the piston type replaceable steel back copper lead lined bearings.

The lubrication system provides automatic valve gear lubrication and features a gear type pressure oil pump driven from the crankshaft. Oil is forced through the crankshaft to all oil bearings, crankshaft main bearings and connecting rod bearings.

Crankshaft is bored to provide oval-shaped sludge scavenging at all passages leading to the main bearings. Pistons and piston pins are lubricated by splash. A series of oil holes is provided between the main crankcase sections and the oil pan. The crankshaft is a one-piece forged steel alloy nitrided type with four throws and three main bearings. Each crankshaft is uniquely and dynamically balanced. The rear gear roller thrust is forced integral with the shaft.

The camshaft is a heat treated forging with hardened lobes and drilled for lubrication and to provide oil passages. Multi-lobe type main and follower with hardened faces and radius operate directly in the crankcase sections. Push rods are steel tubing with hardened ball ends. Forged steel rocker arms are supported on ball bearing pins in the cylinder head and secured in place by screw all end plugs.

Valves of under valves in chrome radial steel and exhaust valves in stainless steel. Aluminum bronze valve seats are rolled in the head. Valve guides are of phosphorus bronze. Valves may be adjusted by means of the screw and locknut ad-

justment provided in the rocker arms. Forged steel split cap type connecting rods employ bronze bearings in the small end and precision replaceable copper lead lined bearings in the crank pin end are used.

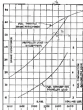
Pistons are cast 20-25 aluminum alloy and are machined with four ring grooves, two compression rings, one oil regulating ring and one oil scraper ring. Full floating type piston pins are used with aluminum alloy plugs inserted in each end. The use of the aluminum piston operating in the cast iron-cased head and integral cylinder liners provides excellent bearing surfaces which eliminate scoring of pistons and rings.

Equipment includes a Bosch-Siemens type SAE5 carburetor. Excellent distribution of the fuel-air mixture in each cylinder under port is obtained by the counter-rotating induction system which is cast directly in the oil pan. Each cylinder has a separate interchangeable intake pipe, by passing through the oil pan the mixture is kept in a more uniform temperature permitting the mixture to expand rapidly to full throttle after long idles. The Scientific SP4L synchro is standard equipment.

Overall dimensions of the Model 65-145-B, which is equipped with single ignition, are as follows: overall length 29.56 inches, overall height 20.12 inches and overall length 25.75 inches.

Specifications are as follows:

Rating at sea level, 65 hp at 2300 r.p.m.
Cruising rating, 47 hp at 2300 r.p.m.
Bore and stroke, 3.75 x 3.75 in.
Displacement, 180.4 cu. in.
Compression ratio, 16.5 to 1
Weight (Single Ignition), 155 lb.



THE AVIATION NEWS

REVIEW COMMENT, FORECAST

DANIEL SAYRE
C. P. McElroy
R. K. Lusk

JULY 1959

United A. L. Wins AVIATION Award

(Story on page 81)



FOUR TIMES FOUR: The Douglas DC-4 (below) proved for that New York Skyline picture at the end of its maiden transcontinental trip. An inset had a million people turned out for a Rockland inspection of the "biggest land plane ever built in America" as it moved across the country in service tests as the "Bogie Bomber" of United's airline fleet. At right, three Boeing Stearman are moved quickly to the ground. Douglas No. 2 is being put through an exhaustive flight tests (Story on page 81).





WRIGHT *Aircraft* **ENGINES**

AVIATION MANUFACTURING

Lockheed in High Gear



Equipped with
NORMA-HOFFMANN
PRECISION BEARINGS

This unprecedented speed was attained under tests by the builders of the above plane—Curtiss Aeroplane Division, Curtiss-Wright Corporation, Buffalo, N. Y. Their successful completion proved the soundness of design and construction, not only of the plane itself but of all the parts entering into it.

NORMA - HOFFMANN PRECISION BEARING were employed in both the engine and flight controls of this plane, as well as in the hinges of the actual control surfaces.

Where the bearings must not fail—on land, at sea, or in the air—NORMA HOFFMANN PRECISION BEARINGS are the choice of engineers and designers of planes, engines (including superchargers), engine accessories, control apparatus, instruments, radio equipment, cameras, and landing field equipment.

NORMA-HOFFMANN BEARINGS CORPN. STAMFORD, CONN. U.S.A.

Lockheed in High Gear

Production at the Lockheed plant in Tucson, Ariz., slipped slightly last year, but still accounted for more than one-third of the 1433 two-engine bomber transports rolled out of the factory every four days, and Lockheed's total production of aircraft planes every two days before last summer. It is now estimated that Lockheed will be able to complete its huge backlog of orders in less than a year. More than 3,000 employees are currently on the payroll compared with less than 3,000 at the start of the year. At the end of 1964, Lockheed had distributed an annual report prepared especially for employees and customers, and it plans to publish a new report in 1965. It is also working to improve its relations with Lockheed's military business, the orders contracts to guide it. For Model 42 transports and Model 440 transports, Lockheed is now building the models T-42A-C and T-44A-C.

In a recent report on first quarter operations, for the

Shareholders ended last Feb. 29, Douglas showed net profits of \$971,822, compared with \$468,771 for the same period last year. Development expenses incurred during the first quarter totaled \$409,472, of which \$387,800 was charged to current earnings. Much of this development work is thought to represent the next stage Army bomber studies.

is four exceeding all previous production records, with 75 planes delivered in April and 90 shipped in May. Most of these

delivered, are agreed: a British order for 400 planes, and a French order for 200 planes, of the basic trainer type, with the possibility that the French order will be increased by an additional 100 planes of the same type. As North American is working on a five-day week basis the present production rate approximates four planes per day.

an aerial tragedy that was used for depth bombing of submarines. The Duplex Crane Equipment Company will devote its attention primarily to difficult technical problems in connection with aircraft design and manufacture, rather than

On the production side both Interstate Aircraft & Engineering Corp., and Aerojet Precision Products Inc., have shown great expansion of their aircraft parts manufacturing work. A statement by Don Smith,

New Firms in California

Subcontracting companies make how is available

for the DC-3 and \$281,730 for the DC-6. Completion of the 1960 DC-3 transport plane was celebrated by Douglas and American Airlines officials on

June 1st, with delivery of the "Oklahoma City" to American Airlines. American Airlines, 100 per cent Douglas equipped, operates 10 Douglas transports.

North American Tunes Out Four Each Working Day

A report issued by J. M. Kinsedger, president, reveals that the earnings of North American Aviation, Inc., during the second period of 1933, ending June 30th, will probably exceed the record earnings shown during the first quarter. Earnings for the three months ended March 31st, last, were \$1,380,000, and net sales for the three months were \$5,075,000. Current

Increasing pressure for military aircraft production is forcing consideration of the expansion of subcontracting firms in the Southern California area.

Latest plant to enter the western field is the Duplex Cinema Equipment Co., of Hollywood. That firm has been working on the same basic design.

business for the year ended April 30, showed a loss of about \$10,000. May business delivered totaled \$40,000, and the monthly volume is expected to double this figure shortly. About 120 men

were on the payroll on June 30, with prospects of increasing this to more than 200 within 90 days. This firm contracts separately for another week for

Douglas, North American, Lockheed, Vultee, and Glenn L. Martin. A statement by Mr. C. A. Berkey, president of Aero-

staff. Potomac Products, Inc., reveals that the engineering department has been increased from one to eight men, and that addition of a night shift during June will approximately double the payroll of 48 persons. Booking of unfilled orders now aggregates \$150,000, although the figure does not include experimental work in progress on a test plus basis Continental Automatics Corp., which recently



THE NATIONAL DEFENDING PROGRAMS, Inc. at 1401, under our direct foreign exchange 100 percent participation and the subsequent national PROGRAMS designed for every last year, and data flow to the United States (1990) and to the

Beaglas Backlog Sets New Record for Industry

Douglas Aircraft Company took another business spur during May with award of the Army contract for manufacture of approximately 21,000,000 worth of twin-engine attack bombers. This brought the Douglas unified program backlog to a new record level of approximately \$28,000,000, and it is believed the Douglas payroll will soon be taxed to new



ONE MILLION SQUARE FEET, will be the floor area of the Paterson, N.J., plant of the Wright Aeronautical Corp., when a series of four relatively minor additions are finished in September. To cost about \$150,000 the new projects add 20,000 sq. ft., 14,000 sq. ft., and 14,000 sq. ft. for assembly.

FIRST FLIGHT PICTURE: The new Grumman Blazerenger, San Diego. In two 2,600 hp. Wright D-560 engines gives

longrange flying but slowest of the three last November's speed

established a great manufacturing plant in Burbank, a company working represents 150 people on the production line of sheet metal aircraft parts for various aircraft companies.

Latus of the Southern California Airplane plant in the Harvard Aircraft Co. Corp. which has ordered 100,000 sheets of 21 per cent copper sheet in the public, proceeds to be used for the construction of additional production facilities, payment for the factory, purchase of other equipment, and working capital. Harvard Aircraft Co. Group Corp. manufacturing plant for every leading aircraft maker in the Pacific Coast, and for numerous other aircraft firms standards of thousands of conventional firms are unexcelled, ranging from electrical shavings to control panels, with readiness made from aluminum, steel, copper, and other materials. Approximately 500 Harvard aircraft parts are to be manufactured in the Douglas DC-4 plant. The company reported net profit of \$100,000 for the third year ended April 30, 1936, but before provision for taxes and excess profits taxes.

Siebesthaler Additions

Two additions to the staff of the Thomas L. Siebesthaler Company, of Kansas City, have been announced by Ted Lark, president of Aircraft Associates Corp., of which the Siebesthaler unit is a wholly owned subsidiary. Robert J. Van Cleave has been named sales manager, and Preston E. Thayer, marketing manager. Thayer will have active management of production and plant facilities of the Kansas City plant. Van Cleave and his staff are giving particular attention to the production of high-wing Douglas biplanes, and are working on the use of an aircraft Van Cleave, formerly with the Pacific States Co., has long specialized in radio sales and engineering. Lark also stated that Aircraft Associates

Corporation will distribute all specialized hydraulic equipment to the fleet through the distributor group, as an subsidiary to the principal offices of the corporation in Cleveland, Calif.

Boeck to Maxson

Latent Commander (U.S.N.) B. Boeck has been appointed vice president in charge of the newly created Coastal Department of W. L. Maxson Company. Mr. Boeck, a Naval Academy graduate and former Navy pilot, joined Boston Avenue in 1925, resigning as an active pilot engineer, and previously had been representative of the Navy's aeronautical engineering laboratory at Philadelphia.

Stankel to Vega

Donner Stankel, veteran aircraft maintenance superintendent, has been named to the engineering staff of the Vega Aircraft Company, according to announcement of Max Stankel president. Stankel will be in charge of inspection and repair for the company, and will be closely related with the manufacturing and field operations of Vega through the fleet control of which a complete, fully equipped, low-wing airplane is now being completed. Stankel has been a pilot for 25 years, and has been associated in night-time work with American Airlines, Delta Air Lines, and Western Airlines. He served the latter firm for the past two years in supervisory position.

Vega Employs 350

Officials of the Vega Aircraft Company, Burbank, Calif., have announced that more than 350 men are now on the payroll at the company's new plant at the foot of California's great flight airport in Burbank. First important phase of the production plant was scheduled to take place during the week and deliveries are expected to start sometime in July.

in shortly thereafter. Five planes are being ordered through the first production lot. Each is powered with two Hispano OH-5 engines driving a single propeller through a common gear box equipped with water pump, oil pump, and oil pump. The Vega carries 11,000 lb. of oil and fuel, and has a maximum speed of 180 mph. It is now in assembly being approximately 200 by 40 ft. in size.

Brown Heads

Fairchild Sales

Fairchild Aircraft Corporation's new sales manager, Richard H. Brown, Jr., joined the firm in 1926 and for three years was president of the Harvard Flying Club. His general experience has been in sales and engineering work, and he has been in charge of the company's sales and engineering work, and he has been in charge of the company's sales and engineering work.

Parker Appliances Branch

Recent addition necessary for the branch in Burbank, California, is the Parker Appliances Company, Cleveland, Ohio, which has established a service and engineering unit in Los Angeles under the personal supervision of A. S. Parker, president.

Torrans Heads Luscombe

J. H. Torrans has been elected president of Luscombe Aircraft Corporation, replacing J. L. Luscombe who resigned in April. The company's new president is a West Tanager, 27, who has been a pilot for 10 years and a pilot shop superintendent. He is currently in sales, the company feels specifically about the future prospects of its popular piston, all-metal turbine.

British Note

John H. Mather, president and managing director of Aircraft Corporation, Ltd. (formerly 201, Los Angeles, Calif.) advises that in addition to manufacturing Consolidated Aircraft Corp. Aviation Equipment & Supply, and

Brown & Dufour (Australia), his company is expanding to export business out of England for manufacturing British aviation equipment. These efforts are being carried out by the firm's London office, and they have sales representatives throughout the British Empire and in leading countries.

Solar Aircraft Company, San Diego

Solar Aircraft Company, San Diego, has received an additional \$20,000 order from the U.S. Naval Academy of Buena Vista, the mercurial and coal wells, according to announcement of Lou Wicks, vice president. Anticipation of this order was said to have been one of the outstanding factors in recently doubling the factory capacity. The new Solar factory building was placed in operation June 1st.

New Firm

Handsome Metal Products Company, has been organized in Los Angeles by Frank Handman, the manufacturer of aircraft parts in California. The company is a wholly owned subsidiary of the aircraft industry. It is a wholly owned subsidiary of the aircraft industry. It is a wholly owned subsidiary of the aircraft industry.

Markay Joins Polak

Recent J. Markay Company, President Engineer with Curtiss Aeroplane Division of Curtiss Wright, has joined the Polak Manufacturing Company of Al-

SWISSAIR



YOU, TOO, CAN

DEPEND ON DOUGLAS



"This Aircraft is the World's Most Advanced"

AVIATION PEOPLE

TWA Takes Over The Page



VICE PRESIDENT: Walter R. Conroy, General Traffic Manager, has been elected vice president of TWA in charge of traffic sales. A former Naval Officer, Conroy has been in the Navy for 15 years working for National Air Transport, United and Eastern before joining TWA a year ago. In his Naval Academy days, he was a first rate football player.



CHIEF OF FIELD SERVICE: Walter A. Hamilton, engaged in Maintenance Engineering since 1935, when he, Jack Frye and Paul Schuler were officers of the Aero Corporation of Gulf Coast, has resigned as Superintendent of Maintenance for TWA to become the Chief of Field Service for Douglas Aircraft. In 1937 he won Aviation's Maintenance Award.



SUPERINTENDENT: Warren Needelf, Assistant Maintenance Superintendent of TWA, since 1933, steps into the post of Superintendent of Maintenance. Twenty years ago Needelf was Maintenance Foreman at Salt Lake City in the first transport technical ground service. After a long Army career, he joined Western Air Express, transferring later to TWA.



CHIEF ENGINEER: G. W. Tomlinson, for many years widely known through the industry for his test flying and high altitude research work, for TWA has been appointed Chief Engineer at Salt Lake City in the first transport technical ground service. After a long Army career, he joined Western Air Express, transferring later to TWA's new Engineering Department.



MISS AMERICAN AVIATION: Miss Katherine Walsh, R.N., was selected in May to go to Miss TWA to the National Air Carnival at Birmingham, Alabama. June 3, as a witness to the Carewair's Aviation Day, Judge Power New Wilson worthy of selection as Miss American Aviation. Specifications—Height, 5' 11 1/2; hair, blond; eyes, blue; gross weight 115 lbs; age, 23. She has been a waitress at the Phoenix San Francisco run by TWA since August 1938.



SCHOLAR: Robert Zimmerman, a graduate of Purdue University, joined TWA in 1932 as a mechanics helper. Two years later he was made project engineer in charge of engine and aircraft construction. Now, as engineer of an Alfred P. Sloan Foundation scholarship, at the Mass Institute of Technology, he will take a year's leave of absence to study business administration at that school. He is the first person awarded with distinction to join the main engineering class and.



SUPERINTENDENT: A. A. Collins, Superintendent of the Eastern Operations Division of TWA has been appointed Region Superintendent at New York with headquarters at New York City. A veteran Army pilot, Collins joined TWA in 1935, flying on with TWA. He succeeded S. D. Walsh who has been transferred as Flight Supervisor to Los Angeles. A. S. Berlin, Flight Superintendent at Chicago will succeed Collins as superintendent of the East Air Division.

Warner Power Range

NOW

90 H.P. to 165 H.P.

The Warner Super Scarab, 165 H.P. at 2100 R.P.M., with pressure lubrication to all valve mechanisms, takes its place, along with three other distinguished Scarabs of lower horse power, to bring Warner performance, reliability and economy to a broader range of modern aircraft. The new Super Scarab provides 175 H.P. for take-off when equipped with two position or constant speed propellers.



Scarab
ENGINES
 90 H.P., 125 H.P., 165 H.P., 180 H.P.

WARNER AIRCRAFT
 CORPORATION
 DETROIT... MICHIGAN

Manufacturers of Alcock Engines, Alcock Wheels and Brakes, Shark Skids, and Many Other Alcock Accessories.

Who's Who in Airline Maintenance

(Continued from page 32)

des, when Chief of Airline Inspection of the Bureau of Air Civil Piers at the isolated several of these conferences, to did Colonel J. Carroll Cross. Major Seiberley went on to state that the Maintenance Inspectors were authorized to attend.

By the time of the Detroit conference, the trend was "white hot" in terms of calling manufacturers' representatives before the Conference. All those who wanted to be heard were called in when the subject on the agenda pertained to their product, not for discussion. This took a lot of time and was valuable to the committee provided it had not lasted appreciably the same story before. No manufacturers to date had broken down the policy of adhering strictly to facts rather than indulging in fancy selling arguments.

At subsequent meetings we endeavored to have the vendor's representatives quickly and used the questionaire method in which we asked what new developments they had to tell us about since the last meeting or if they had anything to report as the result of the discussion at the previous conference. At Reading of Kollsman, for example, reported at the Hollywood meeting on various indicator developments. Jack Pious, formerly of Sperry and succeeded by Jack Pious, attended the conference with data for the committee based on what was discussed at previous meetings. Mr. Seiberley has done a good job along these lines since.

It is the feeling that this procedure keeps the manufacturers "on their feet" and further does not cause the duplicate of any one day the good job being done by the S.A.R. and the Institute of Aeronautical Sciences where the procedure is the delivery of papers followed by discussion.

The recent Maintenance meetings—one recent one, they tell me, had too many speeches—have had some of this but the emphasis is on lacking speeches, doing the job better and more economically.

Each meeting tends to have a theme song. The A.C. was the biggest thing in the minds of the boys at one conference. Stalling screws and burnt valves was another, more time and again, plus the fact that the state of stress. Now as steel rather than steel crank shafts. Once in two conferences

instead of Alford—now its oldest and have to clean it and find parts of the Alfordian Company has told the maintenance boys. Many not bearings are now getting little trouble, they fill a whole bush.

It is strange how one air line might have trouble with a given problem when no one else is. By reason of the first, referred, and spent thousands on a trial, as a chairman who is the last but familiar with Robert Rules of Order, more often than not the air line having the trouble will be a solution before the meeting is over. There is some difficulty now with cylinder head down shaft in certain engines. Cut screw may be the answer. The committee will deal with by the next meeting. Or perhaps the answer will be Harold Thomas' theory which being developed by the Engine Ship Net Co.

We have had a somewhat difficult time getting our present list of the meetings and have had all sorts of systems, using rings of diagrams, and, at the first several meetings, with the help of S. Paul Johnston adding the writer wrote from up volume benefit of diagram. This became responsible when it was necessary to solve in the maintenance at the appropriate time. Fortunately in recent years the writer has some portable mechanical help at the named "buddy" at the Navy and Lt. Ed Turner report in the Secretary of the Navy and the Chief of the Montreal Division, respectively, upon their return from the conference. The notes which they have to write up may be turned over to me and are used as a check on my own. At the New York conference, Mr. John W. Crowley, Jr., Senior Army Ordnance Engineer of the N.A.C.A. kept copies notes from the viewpoint of what the N.A.C.A. could do to help in the air line problems. Then it is only polite to let the vendors check the notes furnished to them. It takes time to get the replies returned and something of a puzzle to get the results together. S. Paul Johnston, mentioned previously, is an honorary member of the committee for services rendered over a period of years. Paul has been a diligent and generous editor in the matters of the magazine as to correct committee activity to date of being

editor of Aviation. The great air line maintenance award is his lady. Credit should be given to Larry Kerley, now of Lockheed and formerly of the Bureau of Air Commerce and the C.A.A., Dick Gaddy, Irving Metcalf, "Jack" Reiser, C. P. Reed, Paul Seiberley, Oscar L. Wilcox, George L. Lumsden, Gayle Swanson, Jack Gisp, Oliver Blais, James Ames, and many others of the C.A.A. and former Bureau of Air Commerce. In their valuable contributions to the committee over a period of years. Also much credit should go to Clay Jones, Oliver Parks, Lew Chasick, T. L. Lott, Lewis Holmes and Meyer Mosier, as well as Abby Wolf, and the aviation schools for representing, for the measure in which subjects have contributed and kept up-to-date in opinion the young men needed by the air line for the maintenance and overhaul of equipment.

There is a lighter side to these meetings. The business sessions of which are three days of hard, intensive work. Some relaxation is necessary. Royal Sander was a marvelous host at Macomb's and arranged some interesting and innocent entertainment at Macomb's. Clarence Ebbins, who discussed a highly productive experience on standardization, and the other took to arranged in New England will go down in history. Tom Goby and his Saturday evening party on Lake St. Clair after the Detroit meeting, arranged to be long remembered. Tom Shattuck's and Chairman Member Rogers Stanley's American Airlines was perfect.

American Airlines and Colonel Garry gave a swimming, luncheon, dancing, golfing and archery business in Lake Michigan in July after the Chicago session. One Lockheed delegate advised they'd be there, one Lockheed secretary was shown up, for which the hostess fortunately had provided and would have been glad to have more.

Maintenance Chiefs

The Maintenance Chiefs of some of the smaller and medium-size lines have developed friendship and in the manner in which they take a moment and prepare data for the meetings. "Doc" Anderson of Chicago and Southern delivered a paper at Dallas on the problems of a shop of its size, which paper has been very widely called for. Mr. Paul Briggs of Continental and R. N. Ruggles of Mid-Continent have both been active and effective in the work of the committee, as has the senior Jim Lathrop and (This is page 36)



CURTISS P-40

Curtiss

ELECTRIC PROPELLERS AGAIN SELECTED FOR U.S. ARMY PURSUIT AIRCRAFT

* Curtiss Electric Propellers have been selected by the U. S. Army for use on the new Curtiss P-40 and Lockheed YP-38 Pursuits, quantity purchases of which were recently announced by the U. S. Army Air Corps. The Curtiss P-40 order represented the largest number of airplanes ever purchased by the Army in peacetime.

Curtiss Electric Propellers have also been selected for the following Pursuit Airplanes of the U. S. Army Air Corps:

P-36A	P-40
YP-37	XP-41
XP-38	XP-42
XP-39	YP-43

CURTIS WRIGHT CORPORATION
CURTISS PROPELLER DIVISION
CLIFTON, N.J.

LOCKHEED XP-38



CURTISS P-36A



CURTISS YP-37



BELL XP-39



CURTISS XP-40

PHOTOGRAPHS

of the
XP-41, XP-42
and YP-43
not released

Who's Who

(Continued from page 18)

his two colleagues, H. G. Aene and Lew Kerner at Westinghouse Airborne. At the Boston meeting a previous year, they were judged by the job being done by Committee Member Clarence Bolton, with ratings up to the system with 30 minutes or so of flying time. He should and does know more about landing gear mechanisms than anyone in the business and he has many links up his sleeve for saving money consistent with doing a good and safe maintenance job.

Raissa Shivel, who has been in the business in the work of the committee for many years, when Westinghouse Airlines—222 McCallie now of the CAA Safety Board Staff was then his boss and a member of the committee—was the joint and efficient presence of one of the best helicopter mechanics and slugs anywhere which is the Bristol line at DeWitt-Rogers recently joined the ranks of veterans (Vips. Applied) and has been succeeded as a committee by Shirley Skates. Jim King of Western Air Express is an old reliable and has contributed to an extremely wide-way view. Peter Haber of National Airways (Florida) has been named at recent conferences at San Jose Hill of Westinghouse-Cadillac. Walter Brown of Canadian Airways and George Penland, Director of Aviation for the Province of Ontario, has been named and qualified, and they claim to have taken away some valuable information toward doing the difficult job they have to do. Bill Miles of Delta has done as excellent job in memorandum and speeches a good share of it to the conferences and the various which are conducted as a result. Dick Weaver and Bill Moore of United are also most enthusiastic workers for the success of the conferences. At the last two meetings Purchasing Agents of the air line have been in attendance and have either provided or followed the conference with meetings of their own. The Purchasing Agent that better acquainted with the problems of the men for whom they purchase.

The informal dinner with informality by Curry Jones, maintenance by Deshler and others, always on a Dutch treat basis, have been successful in the awards of territorial officers and are so conducted by such honored guests as Louis Germain of

the Institute of Aeronautical Sciences and Lew Palmer of the National Safety Council.

Mr. William Lidenfeld, Chief Engineer of American Airlines, is Chairman of the Committee for the forthcoming two meetings. The next one on June 22 through June 14 is to be held at Santa Monica, California.

Coloed John H. Jones, President of the Aeronautical Chamber of Commerce, and Mr. H. W. Ayer, Manager of the Technical Division of the Chamber, have been representing closely with the Committee through the various technical Committees of the Chamber at which 361 April is secretary. There is a constant exchange of group sheets, an appropriate color for safety and on which all Engineering and Maintenance Committees members are unananimous, between not only the air line, but also to manufacturers, toward the betterment of the products used by the air transport industry and in which the manufacturers have cooperated with enthusiasm.

Maintenance

(Continued from page 21)

repair repair work it is necessary for the Curtis-Wright Technical Staff, Grand Central Ave. Tuxedo, (Glebe), to maintain a large shop for instructional purposes alone. It has been found in what arrangement to use this equipment, and the students, to perform sound maintenance and repair work on aircraft and engines, and for this purpose Curtis-Wright maintains an apartment repair system. Many designed aircraft have been completely rebuilt and a great deal of maintenance work is done on all types of planes and engines.

There are a few examples of the larger maintenance shops not operated by the airlines. These are the largest of the kind. One of the best owned had been in the east is that operated at Caldwell State Airport in New Jersey. Another one is maintained on East Boston Airport by later City Airlines, and others among the many on Massachusetts Field, the entire overhaul shop of Clark Palmer and Preston Penderlee Service are particularly worthy of mention at Cleveland General Aviation Corporation, under Jim Berio's skilled guidance, is preparing for the past air side work and for

future expansion. There is plenty of activity in the shops of Stinson, Skyray, H. C. Robbins, Ellice, and Aircraft Service. We could mention many more but space limitations prevent.

The business of servicing airplanes, engines, and equipment is a good one and there is money to be made in it. Many methods have been devised to save time but not at the expense of quality. A heavy responsibility runs upon the shoulders of the maintenance men but his rewards are directly proportional to service rendered.

G-200 Cyclone

(Continued from page 18)

where applied greasewater cement is provided in this section.

Greatly improved bearing service is achieved by the basic lubrication master compound and seal and envelope is provided by the "Wint Sealed Master Seal Bearing," which is now standard with G-200 Series Cyclones. The final Sealed Bearing now carries oil to the landing gear through external passages, eliminating the necessity of drilling the bearing and then breaking the oil film at any point. Lubrication of the master seal bearing is further improved by sealing at each end, which prevents oil from being thrown off before reaching the loaded ends of the bearing. Lubrication to the cylinder wall is now supplied through two special jets in the crankshaft.

The crankshaft is of the conventional two-piece design with the rear crankshaft bolted into the crankpin. An innovation in the G-200 Cyclone crankshaft, however, is the lower portion of Wright dynamic damper in both crankshafts.

Factors for the G-200 Cyclone are illustrated in the following with the ring grooves formed in five. These are grooves for three compression rings and two oil scraper rings along the piston pin and the conventional oil scraper groove. New oil spray jets per revision hold the pins in place in compression work a bearing chamber provided at each end of the piston pin.

Accessory drives are similar to those of the G-100 Cyclone except for the square pin spline drive fuel pump mounted on the rear section and the tachometer and governor control drive on the oil pump. Speed read and direction is provided.

(Turn to page 19)

RIGHT ON THE BEAM - WITH WESTINGHOUSE

MAJOR AIR LINES PROTECTED BY Westinghouse Beams

OF MAJOR importance to aviation operators, pilots and passengers are the accomplishments in flying schedules and safety.

Among these major accomplishments are the 94 Westinghouse Radio Range installations approved by the Civil Aeronautics Authority of the Department of Commerce. These Radio Range Beacons will span the United States from coast to coast—marking a distinct step forward in flying progress—and this company is proud to have co-operated in this pioneering achievement. Westinghouse Electric is Manufacturing Company, East Pittsburgh, Pennsylvania.

Interior view of North Atlantic station, showing Westinghouse beacon equipment, including vibration network, time-meter and station control racks.



In addition to standard instruments, Westinghouse offers special instruments such as the Cross Radio type for low frequency, landing systems, radio and VOR indicators, and other specialties.



Send the free copy of "WRIGHT" the new and improved Westinghouse book on Aviation. Supply 100 in and out the request below.

Westinghouse Electric & Manufacturing Co.,
Department 112
East Pittsburgh, Pennsylvania.
Please send your copy today - 94-21882 - to be one of the following:

Name _____
Firm _____
Street Address _____
City _____ State _____

Westinghouse

ELECTRICAL PARTNER OF THE AVIATION INDUSTRY



A 500 Cycle Blind Landing System

(Continued from page 51)

center also supplies to conductor 2 sufficient current in opposite phase to the current of coilman 1. It coils the resultant magnetic field around cables 25 and 30, in the area between conductor 2 and the landing point, in direction in proportion to the amount of convergence of cables 25 and 30 in the area between conductors 2 and 3. It is a like manner sufficient current is caused to flow through conductors 3, 4, 5, 6, etc., in opposite phase to the current at conductor 1, to cause the resultant magnetic field surrounding cables 25 and 30 to diminish in proportion to the convergence of these cables. The inductances are used to adjust the amplitude and phase of the currents in the various circuits and the inductances secure the magnitudes of the currents. This design provides positive control of the currents in each circuit of the ground system from a central point.

The cross conductors 1, 2, 3, etc., are spaced apart a distance approximately equal to the desired height of the glide path above the magnetic lines from which using spacing no further at the cross position is appropriate being desired. In the case of the Lockheed installation there are 30 cross conductors. The stroke of the glide path above conductor 2 is 800 feet and the distance from conductor 2 to the landing point is 4000 feet, thus providing a 10 per cent downward slope for the glide path. The length of the horizontal glide path between conductors 1 and 3 is 1400 feet. The current in Conductor 1 (#8 D&S gauge) is 5 amperes. The resulting conductance at the intermediate cables 25 and 26 are #10 D&S gauge. The cross conductors are #16 gauge. The total power required for the Lockheed installation is 1.25 kilowatts. The total cost of all materials, installation, and two complete electrical equipments was approximately \$75000. The weight of the Aircraft equipment, including reference loop and 5 pounds of "D" batteries, is 25 pounds. It is placed to vibrate the batteries, in down heavy reference loop cables and is within the total weight is about 10 pounds. The two-channel audio amplifier is approximately a 6-inch cube and weighs 5 pounds.

It is of particular interest to note

that this system permits the establishment of a glide path of any desired slope as covered, the cables may be pulled over hills and valleys and yet a straight line glide path can be established. The Lockheed glide path is straight as shown in Figure 3.

Installing Collector Loops

Figure 3 shows the most simple and effective method of installing the collector loops in the aircraft. An average plane is passed through the face of the aircraft in such a manner that the plane makes an angle of 45 degrees with the lateral centerline of the fuselage. To the inside walls of the fuselage along the line intersection of the fuselage plane with the fuselage, there is secured a small flexible, fabric-covered multi-conductor cable of the later plane type commonly used by the Telephone Companies. The diameter of this cable will range between a quarter of an inch for one containing 30 conductors to a half an inch for one containing 100 conductors. This cable having been secured to the walls of the fuselage so as to describe a complete loop and return to its starting point, the various conductors of the cable are connected in series so as to form a single turn loop which offers little or no resistance to the flow of the inductance and is mechanically unobtainable. In the same manner, a second loop is installed at right angles to the first. Experience has been definitely shown that a magnetic field has no effect on the proper operation of these loops.

As Lockheed's use course of a few power, intermediate frequency, cross-loop type A-N main become as localized is used to guide the pilot in the corner of the glide path from a distance of 50 to 150 miles from the airport. Using this technique and the inductive amplifier to maintain altitude at approximately 500 feet, no difficulty has been encountered in picking up the glide path at so closely the correct position as to require any loss of maneuvering to get directly on the glide path. Once on the 500-cycle glide path, the locator is no longer used.

The multi-conductor and single conductor ground cables are not lead

coated, but are rubber covered and have shield jackets of a Teloron-mulder compound which is thoroughly waterproof and as tough as the steel of an automobile tire. These cables may be placed under by a cable laying pipe or they may be directly on the surface of the ground. Such cables as these have been tested in marine ground for four years without showing the slightest signs of deterioration. Figure 6 is a photograph of the control panel by means of which the currents in the ground cables are regulated and measured.

In summation it is well to review some of the advantages of the system just described:

It is simple, reliable and inexpensive.

Operating costs are negligible and no expensive replacement items such as transmitting vacuum tubes are required.

The system is insensitive to noise and the outer inductances are constant, smooth and instantaneous.

It provides a straight, constant-angle glide path or a curved one if desired.

The aircraft equipment is exceptionally small and light in weight.

The simplicity of the receiving equipment, usually as small as a few feet, is such that its coverage of gain is secured. Furthermore, it is a simple matter to provide the amplifier with a self contained feedback loop which when, by means of a push button, may be caused to supply a controlling signal to the input terminal of the amplifier at any time that the glide channel is reasonably covered of the accuracy of the instrument.

Modified with AC Motors

The present equipment is modified solely by the use of a few AC voltages and meters. Once adjusted it remains adjusted and is unaffected by changes in ground conditions from wet to dry and from snow to clear.

All ground equipment may be underground and will not constitute a hazard in flight operations.

The one possible disadvantage of this system lies in the necessity of reworking the cables beyond the boundaries of the amplifier outputs. This factor is, however, not as serious as it first appears to be. Experiments for the permanent installation of cables under or over the property of neighboring land owners are easily and inexpensively obtained and are so obtained almost daily by the power company and wire communication companies.

New ERCO SHEET METAL SHRINKER!



Forms sheet metal by reducing its length in localized areas . . .

HERE'S the answer to your need for a machine which will change the shape of a piece of metal by shrinking it in localized areas. This procedure, an operation as useful and varied as bumping, can now be performed accurately and easily on The Erco Shrinker. This machine is another in The Erco Line of sheet-metal working machines designed especially for aircraft production. Built to the high standards of Erco Machines, it will operate for years silently and efficiently.

Jobs are instantly removable and interchangeable. They are built with various surfaces and shapes for a variety of materials and uses. Write for Bulletin #18 which fully describes the new Erco Shrinker.



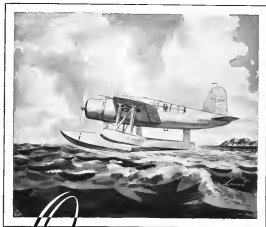
FORMS AND FITS PARTS OF AN ENDLESS VARIETY IN A MINIMUM OF TIME

ENGINEERING AND RESEARCH CORPORATION



DEVELOPED BY
HARVEY
GREENWOOD CASE
(Inventor of the Erco Shrinker)

Telephone
GREENWOOD CASE
Write address:
ERCO-MACHINES



Observation Scout by VOUGHT-SIKORSKY

Here's the OS2U-1—an important new airplane soon to join the Flying Fleet. Sleek, swift and sturdy, this observation scout embodies the experience gained in 21 years of manufacturing high-performance aircraft for the U. S. Navy.

VOUGHT-SIKORSKY AIRCRAFT

STRATFORD, CONNECTICUT

ONE OF THE THREE DIVISIONS OF UNITED AIRCRAFT CORPORATION

AVIATION
JULY 1937
85

Off to Europe

WITH HAMILTON STANDARD HYDROMATIC PROPELLERS



PAN AMERICAN AIRWAYS' giant Boeing-built Clippers, shuttling back and forth between the United States and Europe, are fast reducing the Atlantic crossing to a routine commercial operation—completing America's mastery of both its ocean barriers.

Once again Hamilton Standard Propellers play an accustomed part in the making of aviation history.

HAMILTON STANDARD PROPELLERS
HARTFORD, CONNECTICUT

One of the three divisions of
UNITED AIRCRAFT CORPORATION

AVIATION
JULY 1937
85



TAKE-OFF

- The Blue Winged Teal solves the problem of extra power for take off by pushing with its strong, webbed feet. He practically runs on the water until he has attained "flying speed."

Aircraft, too, is often confronted with the problem of extra power for take off—the difficulty of getting heavy planes loaded with tons of freight and passengers onto the air. And the bigger they come, the more they need this extra power.

Since additional reserve power can come only from improvements in facts and engines, Ethyl engineers are constantly cooperating with aviation engineers in a program of practical research. Together they hope to find advances in engineering that will help lift the giant planes of tomorrow into the air.

ETHYL GASOLINE CORPORATION

manufacturer of anti-knock fuels used by oil companies to improve gasoline

AVIATION

July, 1933

143



Across Europe and Asia by Imperial Airways and KLM . . . over the Pacific by Pan American . . . from the Pacific to the Atlantic by American, United, TWA or Trans Canada . . . and now across the Atlantic by Pan American's newly inaugurated route between New York and Europe. The last great link in round-the-world air service has now been forged!

Boeing, Douglas, Lockheed, Short Empire Boats, Martin and Sikorsky—every type of modern transport on this globe-circling route is equipped with a Sperry Gyroplot, a Sperry Gyro-Horizon and a Sperry Directional Gyro.



Sperry Gyro-Horizon



Sperry Directional Gyro



Sperry Gyroplot

SPERRY GYROSCOPE COMPANY, Inc.

BROOKLYN, N.Y.

AVIATION

July, 1933

(16)

To the man who has yet to buy his first PHILLIPS SCREW



If you were the type of man who loves to putter around a home work shop, you would have been enthusiastic long ago about the Phillips Recessed Head Screw.

It really takes all the work out of screw driving. The screw digs to the driver... you can start it with one hand, even without a pilot hole... it goes in straight... the driver can't slip out and gouge whatever you're fastening... and it turns as easy as a lever!

Now suppose you take the time a man saves putting up a shelf in the pantry and multiply that by the number of screw-driving operations you have avoided your plant. When you realize that assembly houses in all branches of industry have cut assembly time an average of 50% just by changing

to Phillips Screws... you'll get an idea of what to expect in your own plant!

Add the stronger assemblies you get the freedom from burrs and split heads... the improved appearance—and you've got something that you really ought to look into. There's money for you in that Phillips screw!

So here's what we suggest you do. Write today to one of the Phillips Screw manufacturers listed below... get all the facts on, better still, send a trial order... try driving them into a piece of wood—or watch one of your men see them on sheet metal or metal assemblies. We'll bet that when you visualize the savings that could be effected throughout your entire plant

you'll agree that it costs less to use Phillips Screws.



This Recessed Head Screw will help your plant by cut tooling and expense at the same time. It's a real money saver.



PHILLIPS RECESSED HEAD SCREWS

1/4" to 1/2" in length and 1/8" to 1/2" in diameter. (See Phillips Screw Company literature for full details.)

AMERICAN SCREW CO. (Lancaster)
Pittsburgh, Pa.

CHAMBERLAIN PRODUCTS CO.
Burlington, Mass.

CONSTITUTIONAL SCREW CO.
New Bedford, Mass.

CORNING SCREW WORKS
New Britain, Conn.

THE LANSING & LANSING CO.
Cleveland, Ohio

NATIONAL SCREW & WRENCH CO.
Cleveland, Ohio

PARKER LULWIG CORP.
New York, New York

PHILLIPS SCREW CO.
Chicago, Ill.

RUSSELL, SCOTCHMAN & WARD
BOLLY & WITT CO.
Fort Worth, Tex.

SCOTCHMAN & WARD
Baltimore, Md.

IT COSTS LESS TO USE PHILLIPS SCREWS

AVIATION
July 1939
101

4 touch CONTROL



FOUR Touch Controls: the flick of a switch or the touch of a finger and HARLOW response is instant... Flip a switch and electrically operated flaps instantly move to the desired position for a soft, smooth glide and slow landing... Press another switch and electric power operates the retractable landing gear, "up" or "down," in six seconds... Turn a dial and take "aim ship" for wireless flying... Altimeter and elevators are so well balanced that only a finger's touch on the wheel is needed for any maneuver...

These are only four of HARLOW'S many better ways of doing things... For detailed information write HARLOW AIRCRAFT COMPANY, Alhambra Airport, Alhambra, California...

HARLOW

B★A★30

WINS A NEW RECORD BREAKING ORDER

**6,300,000 SQUARE FEET
700,000 SQUARE YARDS
OR ABOUT 400 MILES ...**

Any way you look at it—when the U. S. Army Air Corps awarded the order for 700,000 Sq. Yds. of B★A★30 a new record for peace time orders of airplane cloth was established. We're justly proud of the fact that our B★A★30 was the fabric that set this record and we're equally proud of the performance record B★A★30 has established for itself throughout the world as the finest of airplane fabrics.

B★A★30

WELLINGTON SEARS COMPANY

65 WORTH STREET, NEW YORK, N. Y.

AVIATION
July, 1934
184

Illustration: 800 H.P. in Tornado

8000 H.P. TORNADOES ON SKF BEARINGS AT LANGLEY FIELD

HOME OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

Tornado Type
200 H.P. H.
100 H.P. Pressure
Full-Boat

Motor H.P.
8000
8000
Two 4000

Motor Make
Crescent-Wheeler
Crescent-Wheeler
General Electric

SKF Location
in New
York
City

THERE'S something in the wind of the new Tornadoes of Langley Field. There are tornado velocities up to 500-miles per hour produced by plant 8000 H.P. motors on SKF Bearings.

The satisfactory performance since 1931 of SKF Spherical Roller Bearings on the Full-Scale Tornado and on other smaller Tornadoes led to their use on the newly constructed 500-Mile-Per-Hour and 10-Feet-Pressure Tornado. Just another illustration of the important role that SKF is playing in developing the aircraft of tomorrow. SKF Industries, Inc., Philadelphia, Pa.



ROLLER

BEARINGS

Illustration: 800 H.P. in Tornado

AVIATION
July, 1934
185

EVERY NAVY CARRIER HAS ITS GRUMMAN FIGHTING SQUADRON



U.S.S. RANGER



U.S.S. SARATOGA



U.S.S. LEXINGTON



U.S.S. YORKTOWN



U.S.S. ENTERPRISE



THE USE of Grumman single-engines in the fighting squadrons aboard all five of the mighty aircraft carriers now serving with the Fleet is a mark of high distinction. It reflects the Navy's regard for Grumman aircraft and is a tribute to their outstanding performance and striking power. Grumman aircraft of various types for land, water and deck operations are vital units in all air branches of our National Defense.

GRUMMAN
AIRCRAFT ENGINEERING CORP.
BETHPAGE LONG ISLAND NEW YORK

Circle 11 on Reply plate

INSTRUMENT MAINTENANCE

The Kollman Instrument Handbook—over two years in preparation—is a guide to the test, repair and adjustment of airplane instruments, with special attention to those made by Kollman. Over 500 pictures show every step in the process of testing instruments, taking them apart, and putting them together again. Simply written, and with many tables, charts and technical notes, this Handbook is Kollman's contribution to efficient instrument maintenance.

Price per copy, \$5.00. Students in recognized aviation and instrument schools may secure copies at a special price.



SOUTHERN FIELD SERVICE
NAVY INSTRUMENT CO.
HANGAR 7
FLOYD BENNETT FIELD
BROOKLYN, NEW YORK

KOLLSMAN INSTRUMENT CO., INC.

8006 FORTY-FIFTH AVENUE

ELMHURST, NEW YORK

WESTERN BRANCH: GRAND CENTRAL AIR TERMINAL, GLENDALE, CALIFORNIA

VISIT THE 1942 AVIATION INDUSTRY EXHIBIT AT THE NEW YORK WORLD'S FAIR

AVIATION
200, 170
180



Exide AIRCRAFT BATTERIES



EXIDE AIRCRAFT BATTERIES are carefully engineered for utmost dependability and long life. Proper maintenance develops these qualities to the fullest degree under actual operating conditions, repaying you abundantly in terms of longer service and greater safety at lower overall cost.

To help in establishing the battery maintenance methods best adapted to your requirements, Exide Operating Engineers will gladly advise you. They are thoroughly familiar with such problems as a result of Exide's long experience with aircraft batteries.

Exide for Ground Cranking. Batteries mounted on dollies and used at the airport for ground cranking meet a different type of service from batteries used in the ship. An Exide properly chosen for this service will deliver exceedingly long life. Why not write today for free folder, "Exide Aircraft Batteries"?

THE ELECTRIC STORAGE BATTERY CORPORATION, Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

AVIATION
JULY 1937
113



PESCO flies with the BEST

On all leading airways of America, the finest planes are PESCO equipped. Eastern Airlines' Great Silver Fleet—which earned one of the 1936 safety awards, has for years standardized on PESCO equipment. Western Air Express, America's pioneer airline, likewise flies planes equipped with PESCO products.

Among the PESCO units used on these transports are Engine Fuel Pumps, Fuel Transfer Pumps, Vacuum Pumps for the operation of instruments, Hydraulic Pumps for raising and lowering landing gear and flaps, and Hydraulic Pumps for quick-feathering propellers, Fuel Relief Valves, and other Products.



ALL TYPES • AIRCRAFT PUMPS • VACUUM TUBES

HYDRAULIC PRODUCTS • AIR SPECIALS • ENGINE PARTS

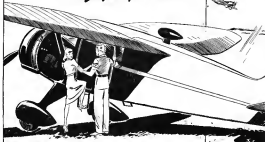
PUMP ENGINEERING SERVICE CORPORATION

12118 TAFT AVENUE CLEVELAND, OHIO, U. S. A.



AVIATION
JULY 1937
113

Fly with *Safety at your Side...*



That means radio? And RCA is your logical selection—because RCA not only offers you everything in aviation radio at moderate prices—but is the popular choice of the majority of pilots!

America flies with RCA! No other where you go you find airplanes of every size equipped with RCA radio apparatus. And to you this is important. For it proves that RCA equipment is the popular choice of smart fliers. Here show more RCA equipment in use on planes in this country than any other kind.

Why this popularity? Four reasons: First—RCA makes everything in aviation radio—receivers, transmitters and radio components for all ships—from smallest to largest. Second, RCA prices are moderate, making

you to get utmost value for your money. Third, RCA puts real quality into its equipment—quality founded on RCA's years of unmatched experience in every phase of radio. Fourth, RCA offers you a nation-wide service radio service organization. That's why it will pay you to equip with RCA apparatus now!

For dependability, it pays to use the values preferred by most pilots and pilots—RCA Equipment. Touchmark. Radio Shack. Big U. S. For. Out by RCA Mfg. Co. Inc.

RCA for Aviation Radio

See our wireless dealers!

At Associates Inc., Gretna, Calif., Chicago, Ill., Garden City, L. I., Dallas, Texas; or your nearest RCA authorized service dealer.

AVIATION
JULY 1935
114



IN 4-ENGINE AIRPLANES ...IT'S BOEING

Only BOEING has a background of full experience in the 4-engine field... a factory completely geared to 4-engine production.



In the realm of large aircraft, BOEING's position is unique. During the past several years this company has concentrated on 4-engine airplanes, and has been the only American manufacturer actually producing fleets of 4-engine planes for service. As a result, not only has it gained all-important experience in the design and production of all types of 4-engine aircraft, but it has built up factory facilities and personnel that are completely adapted to this type of work.

As the numbers of 4-engine planes in production at the Boeing plant have increased, quantity production methods have been developed, and 4-engine Flying Fortress are now being mass-produced by the assembly line method.

Boeing's unparalleled position in the large airplane field is backed by these achievements. It developed the first modern 4-engine landplane and provided the U.S. Army Air Corps with its

initial fleet of these planes, the formidable B-17 Flying Fortress, the nation's mightiest aerial defense weapon. It produced the largest landplane yet built in America, the XB-15 Super Fortress. It produced for Pan American Airways its new fleet of the world's largest flying boats, the 74-passenger transoceanic and transpacific Clippers. It is currently producing and testing the world's first "upper level" monoplane, the Model 307 Stratoliner.*

The newest addition to the Boeing Flying Fortress* series, the advanced type B-17E is now in the Company's production line, being a still further degree of excellence and still higher performance to the present Flying Fortress type with which the Army Air Corps has made such remarkable records—the world's most effective bombardment airplanes.



*Trade marks registered.

BOEING HAS ALWAYS BUILT TOMORROW'S AIRPLANES TODAY

AVIATION
JULY 1935
115

PERFORMANCE IN THE AIR DEPENDS UPON PRECISION ON THE GROUND

Upon valve performance depends speed, power, economy—even life itself. The law the position and minor leak of the valve seats, the better the valve performance and the less the possibility of engine failure.

When extra power is most needed... This new HALL Grinder refines the valve seats of all types of airplane cylinders with unequaled precision and finish. In wet grinding marked patterns leading of grinding wheels which turn and turn the seats. It allows very fast stock removal and gives a true finish that will hold to 10000.

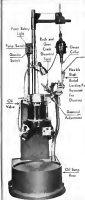
NEW MODEL "AW" HALL ECCENTRIC Wet Type VALVE SEAT GRINDER

The fine precision and finish of any valve seat serviced with this new Grinder are the result of a combination of wet grinding and the HALL ECCENTRIC grinding principle which has been adapted for production as recommended for service by 30 leading engine builders in all parts of the world.

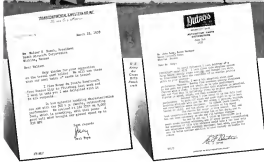
THE HALL MANUFACTURING CO.
1232 WOODLAND AVE. TOLLEDO, OHIO, U. S. A.



Below is shown the HALL Model 80 Wet Type Valve Refacer which is so necessary as these shops where stainless-steel valves are used. Dry refacing leaves the valve face and causes checking. All stainless-steel valves should be HALL WET GRIND. Write for book describing HALL Valve Grinders and Valve Refacers.



Expert Opinion!



★ It is a pleasure to receive letters from Beechcraft pilots concerning their satisfaction and surprise at obtaining more performance than they actually expected. The consensus of unbiased expert opinion is that Beechcrafts deliver performance and handling ease that is really unique. Ask your Beechcraft dealer to prove that a Beechcraft will cruise faster, land slower, and handle easier than any comparable airplane. The more you know about other airplanes, the better you will like the Beechcraft.

BEECHCRAFT CORPORATION 441 EAST CENTER, WICHITA, KANSAS 67201

BEECHCRAFT

HALL ECCENTRIC VALVE SEAT GRINDERS

AVIATION
July 1939
115

AVIATION
July 1939
117



CUTS ASSEMBLY COSTS FOR BLIND ATTACHMENTS

Volume Use of LOK-SKRU Fasteners Now General in Aircraft Industry

Specifications of Lok-Skru Fasteners by so many design engineers is the result of extensive tests proving the greater strength and lower cost of this unique method of making blind attachments. Available in various lengths and types for metal fasteners from .010 to .145 Lok-Skru Fasteners have such wide adaptability in modern production that new uses and advantages are being found constantly. They are Army and Navy approved. General applications now include attachment of horizontal stabilizer ribs, wing ribs, nacelle ribs, exhaust tail pipe lining and shielding, motor upholstery panels, door and window frames, head bolt covers, master boxes, etc. Your inquiries regarding specific applications and services are invited.

The Bill Manufacturing Co. • Cleveland, O.
BRONX • DETROIT • LOS ANGELES • TORONTO

LOK-SKRU FASTENERS

1. Reduces installation time.
2. Requires only one man to install.
3. Only one drilled hole needed.
4. No flush heading necessary.
5. Eliminates cutting slots.
6. Not affected by oil or heat.
7. Screw locking device positive and long wearing.
8. Greater strength and safety.
9. Lowers total production cost.

JUST TAXI UP AND STEP OUT IT'S AS EASY AS THAT WITH EDO FLOATS



You step on Edo Floats, with water cushions, land them as easily as a canoe. A gentle glide to beach or landing strip—and you step out! No wing tip floats to bar your way—no steps and no extra load on your crowded deck. And a hot line to help you shoot down over land, water and up! Float straight to your destination. No jerking for a landing, no gas squawking with heavy air loads. Your "Edo float" is your own—your floating plane can maneuver here, take off or land. Your approach made—the plane is on the beach—no extra large shore land or a long plane of your own.

Edo Floats are like things like with the a hot line of your plane. For complete details, address: Edo Aircraft Corp., 410 Second Street, College Point, L.I., N.Y.



AVIATION
July 1937
119

Umberto Nobile *Joins* FORMER GENERAL OF ITALIAN ROYAL AIR FORCE



FACULTY OF LEWIS HOLY NAME SCHOOL OF AERONAUTICS

A FEW HIGHLIGHTS OF SPECTACULAR CAREER OF UMBERTO NOBILE . . .

- ★ Director of Aeronautical Construction during World War.
- ★ 1925-26, Colonel Umberto Nobile, designer of the dirigible "MORIS" flew over the North Pole with Amundsen and 14 others.
- ★ 1928, the "Italia," commanded by Nobile, now a general, makes polar flight.

This school offers a new type of opportunity where, too, will include and graduate on longer more intensive work under actual conditions of experience for its aviators. Only students of high moral caliber, and those who wish the intensive best way to a career in this field will be admitted. The Catholic authorities at Chicago authorize this course for the finest school of flying and as such has been opened to aviators the (1937) requirements of writing up a school of the qualitative type for this specialized phase of education.

New Catalog SEND FOR IT . . .



LEWIS HOLY NAME SCHOOL OF AERONAUTICS
LAKESHORE, ILLINOIS

Please send me the Catalog

Name _____

Address _____

City _____

State _____

LEWIS HOLY NAME SCHOOL OF AERONAUTICS
LAKESHORE, ILLINOIS

AVIATION
July 1937
120

IMPROVED DESIGN FOR THE OPERATOR AND PRIVATE OWNER



Porterfield Turner
Model 50

BUILT FOR SPEED
EXCELLENT VISIBILITY
LARGE CARGO SPACE

Equally well Suited for Student Training and Cross Country Application

1240-1250 1933, 1250-1260 12 to 16 seats
to carry 1000 lbs. cargo—loading almost
as fast as 1931 Ford closed top for 1000 lbs.
transporting 1000 lbs. cargo when the loader
part is left open.

Look Visible Tendency to Fall Available
for Instruction and Practice



This new leader in the light plane field has a new appearance and gives eight
passengers. It is a high wing light airplane with two 100 stroke instead of
the conventional Vee type ones. From the nose to the tail it is completely covered
so as to fly into the air with a minimum amount of air resistance. Powered by
Continental Air-cooled, four cylinder, constant type engine, developing 20 h. p. at
1900 r. p. m. Fuel consumption is approximately 18 1/2 gallons per hour at 27 miles
per hour. The plane is completely equipped with instruments—engine, altitude
gauge, etc. Dual stick controls and brakes—complete instrument board.

PORTERFIELD AIRCRAFT CORPORATION

S. E. PORTERFIELD, JR., Pres.

ED. S. TURNER, V.P.

1726 Webster Avenue, Kansas City, Missouri

BENDIX-SCINTILLA
Aircraft Magnetos

**had to deserve leadership
to win it . . . and hold it!**

It is not at all difficult to prove that Bendix-
Scintilla Aircraft Magnetos provide the very
best quality for the world aircraft . . . that fact has
been exhaustively proved to the entire satisfaction
of every airline in America, as well as the
Army, the Navy and all other Federal service
branches. It is quite certain that the superiority
of Scintilla performance is the basis of the
universal preference.

SCINTILLA MAGNETO

DIVISION OF BENDIX AVIATION CORPORATION
Edison, New York



AVIATION
July 1933

139



*Pioneering, 1939 STYLE,
is a mental process*

1919 In the early days of commercial and
military aviation, instruments developed by
Pioneer contributed to the history-making
flight of the NC-4 and the early Air mail Service.

1939 Here is a very new plane, equipped
with every helpful facility of applied science
and mechanics, that *pioneering* goes on.

Today as in 1919 instruments pioneered by
Pioneer form the nerve centers of the modern

airplane. Pilots, navigators and flight engi-
neers depend on the reliability and accuracy
of Pioneer instruments in super-airliners,
transoceanic flying-boats, military ships, cargo
carriers and private airplanes.

The universal approval of Pioneer instruments
throughout the aircraft industry makes the
Pioneer continuing program of development
possible, first by inspiring it, second by mak-
ing it commercially practicable.

PIONEER
INSTRUMENT COMPANY, INC.

BENDIX, NEW JERSEY

(Subsidiary of Bendix Aviation Corporation)

AVIATION
July 1933

141

Be Prepared

Secure Your Instrument
Flight Training from
the Specialists at



**PARKS
AIR
COLLEGE**



A student in flight.

At Parks you have the advantage of complete intensive experience in the highly specialized art of flight instruction. The air pilots giving this instruction have a total of 22,000 hours in various flight ratings.

For pilots with at least 500 hours logged, an advanced course of 25 hours in Radio Work and Instrument Flight is offered. Approximately 12 hours of this time is used in the high altitude working out instrument problems. Seven methods of instruction are used. The balance of this time is spent in the air under one-on-one instruction. Instruments are used for our work.

From four to six weeks, depending upon the aptitude of the student, are required for the completion of the course. The fee for the 25-hour Radio Working together with the required training in ground subjects is \$210.00.

Since this is a special course of training, pilots may enter at any time but, unless a certificate is not issued, be given to avoid delay on return.

In many months, 10 experienced pilots have earned for instrument flight ratings. A number have gone upon the flight instructor's course and others have been employed as flight instructors. In the case of instrument, four have earned or are in training positions.

As best pilots must have, and all four country pilots should have, the course must train. In the air, the student must do it.

Bring yourself up to date, increase your value to your company and to yourself by making the steps of your flight expert course with this specialized training. Write at once for full information, or give date of arrival.

PARKS AIR COLLEGE
1435 27th Avenue, Elmhurst, Ill.

There is no Substitute for EXPERIENCE



Solar engineers add the 20 years of experience to their own, to give Solar manifolds an unbeatable record of performance.

PAINTSTAKING years of experience provide the only road to the Chief Dispatcher's office!

It is this same experience quotient which Solar offers the buyers of manifolds, by virtue of the fact that Solar pioneered the field in the use of corrosion-resistant metals.

Solar manifolds stand up because Solar engineers and craftsmen have learned by years of specialized effort how to design and build away extra hours of performance into them.

SOLAR
Aircraft Company
LINDBERGH FIELD • SAN DIEGO
NEW YORK • 50 E. 42nd ST.

IT PAYS TO SPECIFY EXHAUST MANIFOLDS

IT'S IN THE NAVY NOW!



**THE JUNIOR XACTO METER
WITH THE**

NEW

**INDICATING -
RECORDING -
INSTRUMENT**



Equipped with two set-back pointers and one of four rotating pointers. D.C. operated. Indirect measurement.



The space-saving Dual Indicator system can be installed in spare the rate of consumption of fuels of low response. Service panel space.

The U. S. Navy Department knows... that an "accurate" check on airplane fuel consumption makes it possible to secure utmost efficiency from meters and fuels—to obtain maximum cruising range with minimum fuel load—and to operate at peak economy. That's why it recently placed on order for a number of Junior Xacto Meters with the NEW Indicating-Recording Instrument—the instrument that indicates the rate of flow and records the amount consumed.

To know ALL about fuel consumption, install the Junior Xacto Meter—the meter especially built for aircraft service. Fully tested in actual flying service, it has proved the ideal way to check fuel consumption accurately. Write for complete details.

S. F. BOWSER & CO., Inc.
1201 Coughlin Ave.
FORT WAYNE, INDIANA, U.S.A.

**AND OTHER TYPES OF RECORDING INSTRUMENTS TO
MEET INDIVIDUAL NEEDS**

BOWSER ALSO MANUFACTURES a complete line of testing equipment including Exhausting Pumps, Debiting systems, Portable systems, Flaming Duck System and special systems for individual requirements.



**PIONEER
MANUFACTURERS
of**

**REFUELING SYSTEMS AND
FUEL CONSUMPTION METERS**

Fly the Airplane that is built like a Transport—"ALL-METAL"
THE LUSCOMBE



THE LUSCOMBE '50'
Only \$622.00 Down
\$1655.00

THE LUSCOMBE '45'
Only \$459.00 Down
\$1975.00

The only "80" and "85" horsepower airplanes on the market with "ALL-METAL" monocoque fuselages, "ALL-METAL" wing spars and ribs. The added safety of "ALL-METAL" construction is self-evident. The basic fact—the unequalled performance—the inherent beauty of design and finish, makes the Luscombe the outstanding airplane value today.

Waltz Dept. N for descriptive literature

Merger Airport • LUSCOMBE AIRPLANE CORPORATION • West Trenton, N. J.



AERONAUTICAL Drafting and Design

A Vocation with Increasing Opportunities

THIS DRAFTING and Design Course prepares the student for a position in the engineering department of an architectural or a mechanical or civil engineering office. It includes instruction and practice in Engineering Mathematics, Applied Mechanics, Strength of Materials, Stress Analysis, Electricity, Airplane Drafting and Design.

A Master Medicine Course and a Short Vital Course are also given. Write or call for full particulars, stating age, education, and which Course interests you.

The School of Aeronautics
STEWART TECHNICAL SCHOOL

Page 117-118 West 44th St. New York City



WITTEN, M.D., ED.

4301 N. LINCOLN BL., CHICAGO

大野正徳、野田山陽
2002、2003
2004

**NOW... A PORTABLE
ZENITH THAT WORKS
IN PLANES...**

\$29⁹⁵

Stewards -
of special
interest to
you ...

..And trains..
and autos..
and boats..
and any-
where else



—a long list—a portable radio which will guarantee the plane message—

—if private reception is desired, ear-
phones are provided—
—if everybody wants to listen the loud speaker op-
erates—



—in plants, veins, bones—everywhere

—the detachable WAVEMAGNET (patent pending) built in, psi sensitive, 100% accurate, 100% reliable.

... makes the unique portable Zcash possible.



just snap off the removable Wave-snap contained in the back, & attach it to window or porch and the quality of the response will amaze you. Tryin' is believin'.

—carries in one hand—self powered by 300 hour non-pilot battery pack—used under all ordinary circumstances works without outside aerial—outside wires or ground.

—also—for home use, plugs into any 110 volt AC or DC light socket—battery automatically disconnects and resets—use and try the new Zenith Portable with removable Wang-mag.

^aPeaks slightly higher on the left.



ZENITH
LONG DISTANCE RADIO

IT'S A NEW INVENTION...IT'S DIFFERENT
ZENITH IS *AGAIN* A YEAR AHEAD

REVISED
July, 1997
1997

RYAN



The efficiency of the high performance, economically operated Ryan Stearman biplane has been recognized by the U. S. Army Air Corps as well as by the Air Forces of many other foreign countries. Ryan Aircraft Company, Glendale, California, U. S. A.

CONTRACTORS TO THE
U. S. ARMY AIR CORPS

Vibration has no effect on this SELF-LOCKING NUT



It's built-in resistance, a nut will not come on long as the thread changes of half and not on half in process.

The problem is to maintain that pressure without when vibration strikes it and Elastic Stop Nut provides the solution. These nuts are made in the locking element in each nut is composed of a resilient non-metallic material which acts as a vibration dampener. Further, the locking element is tapered with the nut, making the entire unit secure. That is why Elastic Stop Nut has built-in resistance under all conditions of service.

CAN AVIATION ACCEPT A NUT THAT IS LESS SAFE?

See the Elastic Stop Nut Exhibit in the Aviation Building at the New York World's Fair.

Write for Catalog explaining the Elastic Stop Nut and Elastic Stop Nut available.

ELASTIC STOP NUT CORPORATION
1000 BROAD AVENUE • ELIZABETH, NEW JERSEY



VERSATILITY Is Our Middle Name

The illustration above, portraying the various uses of our lathe cylinder and head assemblies mounted on our lathe machine, is but one of many examples to which we might point as evidence of the wide range of machine work that we perform for leading makers of aircraft and automotive engine parts. If you have a diverse machining problem, we are in a position to help you.

Write Us Concerning Your Requirements

THE
GOVRO-NELSON
COMPANY

1921 Adelphiette Detroit, Mich.

For Aircraft Factories or Repair Shops



"HALLOWELL" STEEL WORK-BENCHES have these outstanding advantages

SMOOTH WORKING SURFACES
... no warping, twisting, or sagging ...
... no warping, twisting, or sagging ...
... no warping, twisting, or sagging ...

LASTING RIGIDITY
... no warping, twisting, or sagging ...
... no warping, twisting, or sagging ...
... no warping, twisting, or sagging ...

EASY MOBILITY
... no warping, twisting, or sagging ...
... no warping, twisting, or sagging ...
... no warping, twisting, or sagging ...

STANDARD PRESTEL STEEL CO.
POMERANTOWN, PENNSA.
CHICAGO
CINCINNATI
INDIANAPOLIS
SAN FRANCISCO

TWO-WAY RADIO for the Small or Large Airplane

The Aeronaut Model "B" series of superheterodyne receivers are supplied in completely air battery operated receivers or coupled with dynamo or generator drive. The receiver measures 4 1/2" high and 7 1/2" deep and weighs 2 lbs. 5 oz. The model "B" Aeronaut Model receiver covers the frequency range of 300 K.C. to 500 K.C. Receiver and Weather Band, and 200 K.C. to 400 K.C. Communication Band.

Model "B" Receiver
... completely air battery operated.
Model "B" Receiver
... 4 1/2" high and 7 1/2" deep.
Price complete \$14.00



All models are supplied with approved lightweight head phones, 8 ohm, 4 ohm, 2 ohm, and battery box or 44.5 volt dynamo, and all necessary interconnecting cables. Total weight with all accessories—11 lbs. 12 oz.

MODEL "B" TRANSMITTER: The Model "B" Aeronaut Model transmitter is a compact, efficient, medium power, variable transmitter. Its physical size is 4 1/2" high, 7 1/2" deep, 7 1/2" wide. Weight—2 lbs. 5 oz.

THE "B" IS ECONOMICAL, A SMALL BATTERY BAY AND HAS PLenty OF OPERATING RANGE



Carrier output — 2 watts, 200% modulation, 11 volt input is 1.75 amperes.
Price complete with all accessories, including dynamo, with various accessories, tubes, crystal, antenna and ground cable — \$18.00

MODEL "B" RECEIVER, TRANSMITTER, AND BATTERY BAY

ing dynamo supply, metal tube mount, transmitter, head phones, tubes, antenna or interconnect and interconnecting cables, is 11 lbs.

Price complete with all accessories — \$174.00

See your dealer or write,

AEROVOICE INC., Inc. L. I. N. Y.

WHERE TO BUY

NEW EQUIPMENT—ACCESSORIES—MATERIALS—SERVICES

THE CASTLE-WILCOX INSPECTION WINDOW



A Tilt Ray can be used to inspect all parts within wings and fuselage in actual flight.

A Tilt Ray can be used to inspect all parts within a wing and fuselage in actual flight.

Write for details today!
HAROLD M. WINKLE
Bristol Airport, Tennessee, U.S.A.

PHENIX AIRPLANE DOPES

CLASS and FORMULATED
PHENIX AIRCRAFT PRODUCTS CO.
888 Main St.,
Wilmington, N. C.

AIRCRAFT FINISHES

Standard Aircraft Finishes
TITANINE INC. UNION, N. J.

STANDARD AIRCRAFT FINISHES

Standard Aircraft Finishes
TITANINE INC. UNION, N. J.

AMERICAN FLEX SHIP

AMERICAN FLEX SHIP
AMERICAN FLEX SHIP
AMERICAN FLEX SHIP

THE Where To Buy Section of

Aviation supplements other advertising in this issue with these additional announcements of products and services essential to readers' aeronautical work. Check it carefully, each issue.

DEPENDABILITY

AEROMARINE INSTRUMENT CO., INC.
452 Fairfield Ave. Stamford, Conn.

Sole representatives for Aeromarine, Inc. in the U.S.A., Canada, Mexico, Central America, South America, Europe, Africa, Asia, Australia, New Zealand, and the Pacific Islands.

BOOKS

DON'T GUESS... KNOW!!

100 QUESTIONS
100 QUESTIONS
100 QUESTIONS

100 QUESTIONS
100 QUESTIONS
100 QUESTIONS

POWER PUBLISHING COMPANY
18 CLINTON ST. NEWARK, N. J.
THE POSTMAN WILL DELIVER

Practical Aviation Instructions

Practical Aviation Instructions
Practical Aviation Instructions
Practical Aviation Instructions

AIRCRAFT DIRECTORY

AIRCRAFT DIRECTORY
AIRCRAFT DIRECTORY
AIRCRAFT DIRECTORY

GETTING A JOB IN AVIATION

By CARL MORRIS

Now look below you know "Should I go into aviation?" and "Where can I go?"

Based on personal research right in the offices, shops, and airports of the industry. Comes complete with authoritative references, ground and air jobs, salaries, companies, and organizations. Gives duties and responsibilities, business qualifications, various professional positions, etc., where to get training and what to learn. Favorite opportunities for the future. Price \$2.50. Send 3 to be approved.

McGRAW-HILL BOOK COMPANY, INC.
330 W. 42nd St. New York City

Exceptional Beechcraft Offers

Exceptional Beechcraft Offers
Exceptional Beechcraft Offers
Exceptional Beechcraft Offers

AUTHORIZED Sales and Service

Means Genuine Parts and Expert Service For YOU!
AUTHORIZED: Pioneer & Sperry Sales and Service
Glenwood Sales and Service
Highway Fabric—Glenwood Sales
Pioneer Sales—General Supplies
Mogeflex Service, License No. 144

SNYDER AIRCRAFT

Manitowish Airport Chicago, Illinois

SAC INSTRUMENTS

SALE US FOR INSTRUMENTS
SALE US FOR INSTRUMENTS
SALE US FOR INSTRUMENTS

AVIATION APPRENTICES

AVIATION APPRENTICES
AVIATION APPRENTICES
AVIATION APPRENTICES

YULTE Y-1A TRANSPORT AIRPLANES

YULTE Y-1A TRANSPORT AIRPLANES
YULTE Y-1A TRANSPORT AIRPLANES
YULTE Y-1A TRANSPORT AIRPLANES

STINSON

STINSON
STINSON
STINSON

STUCK

STUCK
STUCK
STUCK

FESTER'S PROPELLERS

FESTER'S PROPELLERS
FESTER'S PROPELLERS
FESTER'S PROPELLERS

POWER PUBLISHING COMPANY

POWER PUBLISHING COMPANY
POWER PUBLISHING COMPANY
POWER PUBLISHING COMPANY

Approved

By the Army Air Corps

FOR BOTH FLYING & MECHANICS

In the center of the Southwest, bright with sunshine and clear flying days the year around, SPARTAN's location at Tulsa, "Oil Capital of the World", is in the heart of the Petroleum Industry, LEADING USER OF AVIATION EVERY DAY IN THE YEAR. Occupying two of the largest and most modern hangars in the United States, SPARTAN facilities include modern Classrooms, fully equipped Machine, Sheet Metal and Welding Departments, Restaurant and Dormitories for students well being. Only latest types of flying equipment employed.

THE highest possible endorsement of SPARTAN TRAINING is the decision of the Army Air Corps to use Spartan facilities for instruction of BOTH Flying and Mechanical Students in the Army Aviation Program. The Army recognized SPARTAN's ideal location for all-year flying weather and country, insuring personnel, College or University day by day planned curriculum and modern facilities for both Flying and Mechanical instruction. The reason the Army is using Spartan for Military instruction is the reason you should first consider SPARTAN for YOUR Aviation Training to assure a successful career in Commercial Aviation. The goal attained by hundreds of SPARTAN Graduates.

SPARTAN SCHOOL OF AERONAUTICS

IN THE *Oil* CENTER of Nature's IDEAL Flying Country

SPARTAN SCHOOL OF AERONAUTICS, P. O. BOX 2649, TULSA, OKLAHOMA

Send me a copy of the 1947 Flying Machine catalog and information describing its Small Engine Flying, Mechanical and Radio Courses of instruction, tuition and detailed flying equipment.

NAME _____ AGE _____
ADDRESS _____ CITY _____ STATE _____

Any Previous Flying Experience?

HOME OF THE DAWN PATROL

Check before sending of
accompanied you are
most interested in

- ☐ BIRTH
☐ MARRIAGE
☐ DEATH CERTIFICATE
☐ DIVORCE DECREE

Get the Plus Value OF CAREER TRAINING AT CALIFORNIA FLYERS



Above: P-51 Mustangs in flight.

Below: P-51 Mustangs in flight.



WESTERN AIR EXPRESS: ONE OF THE 54 MAJOR INDUSTRIES THAT MAKE SOUTHERN CALIFORNIA THE NATION'S AIRCRAFT CAPITAL—The best place to start both your training and your career

Right Now, leaving Los Angeles for Boulder, Colo., Salt Lake City, Yellowstone and Reno, Nev., and the west Western Air Express Douglas wings its way northward over the National Parks. Every day long in the busy offices Western Air Express Los Angeles headquarters their work, each company are serviced, large efficient crews on the ground maintaining the great fleet. The center some other place in the Los Angeles days of American Airlines, Transcontinental and Western Air and United Airlines, for this is not just a passenger line but one of the most important transportation divisions and networks. Los Angeles is America's Aviation Center, not only in flying but in building it, too. For here are the great plants of Douglas, Lockheed, Northrop, North American, Vought and Vega. It is here where 100% of America's commercial airplanes, bombers and service airplanes are employed. Built in the heart of all the aviation activity in the SOUTHWEST Los Angeles Municipal Airport is California Flyers, a U. S. Government and industry-approved school that trains young men for careers in Los Angeles' great aviation industry. Because California Flyers is a vital part of this great aviation center, having so intimately the needs of the industry, it presents its qualified young men in unexcelled opportunity to learn the practical, ready-to-use aviation.

And in Los Angeles, California Flyers is directly government-approved school offering courses in all phases of aviation operation; from the flight officer, the commercial pilot, the master mechanic, his equipment is more modern and complete, includes the latest C. Type 444 Trainer, a complete list of training planes. By western industry approved, an instructor, men with years of active experience. And the opportunity for young men are here, enjoyed in California Flyers' record of industry-employed graduates who have proved by California Flyers philosophy, that of training here where the opportunity is greatest.



C. H. Henshaw, former Western Air Express pilot, instructor in flight, California Flyers, and of the first school of this division.



John W. Henshaw, former Western Air Express pilot, instructor in flight, California Flyers, and of the first school of this division.

CALIFORNIA FLYERS, INC.

SCHOOL OF AVIATION

Approved by The Civilian Pilot, Ground and Mechanics Rating
LEARN ABOUT THIS COMPLETE RANGE OF PRACTICAL CAREER COURSES

CALIFORNIA FLYERS, INC., School of Aviation, 1000 N. 10th St., Los Angeles, California. Send me information regarding the following courses and equipment requirements:

☐ Commercial Pilot ☐ Instrument Pilot ☐ Ground School ☐ Night School ☐ Night School ☐ Night School ☐ Night School

Name _____ Age _____
Address _____ City _____ State _____

HELP WANTED

Demand for Aircraft Workers Is Greater than the Supply

The big employment need in the U. S. today is the flying and for skilled aircraft workers. America is now producing aircraft faster than ever before and needs men to do the work. To prepare you for these positions, Ryan offers the Master Mechanics Course, which gives you the latest aerial, aircraft and mechanical knowledge. Graduates receive a diploma and a certificate of proficiency.

In addition to the completion of the course, Ryan student graduates are able to receive immediate employment with all planes in the world. Graduates are also able to receive a salary with the Ryan Aircraft Company. If you can apply yourself to the course, there is a job with a real future in aviation for you. Send for complete details today.

LEARN BY DOING IS THE RYAN WAY OF TRAINING

RYAN RECOMMENDED GRADUATES GET THE BETTER JOBS

RYAN SCHOOL OF AERONAUTICS
FLYING • MECHANICS • ENGINEERING

RYAN SCHOOL OF AERONAUTICS • Lombard Field, San Diego, Calif.

- Send me information on course details.
- | | | |
|---|--|---|
| <input type="checkbox"/> Flying Courses | <input type="checkbox"/> Police Commissioner's License | <input type="checkbox"/> Airplane Building and Repair |
| <input type="checkbox"/> Commercial | <input type="checkbox"/> Airplane Mechanic and Repair | <input type="checkbox"/> Marine Mechanics and Flying |
| <input type="checkbox"/> Private | <input type="checkbox"/> Airplane Mechanic | <input type="checkbox"/> Airplane Mechanic |
| <input type="checkbox"/> Other | <input type="checkbox"/> Airplane Mechanic | <input type="checkbox"/> Airplane Mechanic |

Name _____ Age _____
Address _____
City and State _____ State, Zip or Type _____

ROOSEVELT is a pioneer in the aviation field. It is the only school of its kind in the world. It is the only school of its kind in the world. It is the only school of its kind in the world.

AVIATION
July 1939
101

Students Plot a Flight and Test an Engine



Preparatory to his first cross-country flight, the student is required to log out his course. His work, under the supervision of an Instructor, is checked at every point. Result: A successful flight with complete confidence on the part of the student.

After students have overhauled an engine, it is put on the test block for check-up. Thus, a student learns exactly how well his work has been done. Result: Confidence in his mechanical ability.

CONFIDENCE

ROOSEVELT AVIATION SCHOOL feels that instilling confidence in the student is a fundamental and necessary part of his training. We can teach him all about flying, and we can teach him all about mechanics, but when he gets out on his own, he has got to have complete confidence in himself and in his ability to do his job at the training we gave him is to make him a success in aviation.

Believing that to be beyond argument, we stress self-confidence in every branch of our training.

Roosevelt Aviation School

Accredited by the U. S. Civil Aeronautics Authority. Licensed by the State of New York.
AVIATION TRAINING AT ITS BEST SIGN AND MAIL COUPON TODAY



Direct Action

FALL CLASSES START SEPT. 25, 1939

ROOSEVELT AVIATION SCHOOL—at Roosevelt Field, Mineola, Long Island, N. Y.

Without obligating you, send details of course desired:

- | | | |
|--|--|--|
| <input type="checkbox"/> SOLO FLYING | <input type="checkbox"/> COMMERCIAL FLYING | <input type="checkbox"/> LIMITED COMMERCIAL FLYING |
| <input type="checkbox"/> PRIVATE FLYING | <input type="checkbox"/> AIRCRAFT DIRECTORIAL | <input type="checkbox"/> AIRCRAFT TECHNICIAN |
| <input type="checkbox"/> MAINTENANCE AIRCRAFT MECHANIC | <input type="checkbox"/> MAINTENANCE AIRCRAFT MECHANIC | <input type="checkbox"/> AIRCRAFT MECHANIC |
| <input type="checkbox"/> AIRCRAFT MECHANIC | <input type="checkbox"/> AIRCRAFT MECHANIC | <input type="checkbox"/> AIRCRAFT MECHANIC |

Name _____ Age _____



Direct Action

AVIATION
July 1939
101

ALL METAL Spartan Executive

THE WORLD'S MOST MODERN TRANSPORTATION

Choice of business leaders the world over, the SPARTAN Executive carries as many as 115 miles per hour, is 100% All Metal WITH NEARLY NO OTHER LANE COMPARE. With the Safety, Quickness and Speed that ONLY ALL-METAL construction can provide, the Executive is unexcelled in comfort, luxury and comfort of riding options. In addition to its unexcelled performance of speed, safety, flying ease of control and short landing distances, many of the safety features that make

the Executive your choice, were pioneered by SPARTAN in daily operation throughout the World SPARTAN Executive are proving an investment in their careers, valuable to ANY form of transportation. Let us DEMONSTRATE HOW THE SPARTAN Executive WILL PROVE A PROFITABLE INVESTMENT IN YOUR BUSINESS. A phone call, stopover or lease will bring the facts to your desk.



SPARTAN AIRCRAFT COMPANY

BUILDERS OF THE BUSINESS MAN'S AIRPLANE, THE SPARTAN EXECUTIVE AND MILITARY CONVERSION 76-F

TULSA, OKLAHOMA

TOMORROW'S AIR TRANSPORTATION TODAY

AVIATION

July 1933

141



TO BE *Highly* STRESSED!

On the sketch above the artist has highlighted a few of the vital parts of a plane. One is the landing gear, built solidly to strike hard bumps with the impact of tons of metal coming at a million-



Forging Alcoa Aluminum Alloy for wheels and axles.

For these and many other parts in light aircraft, designers rely standardly on forgings of Alcoa Aluminum Alloy. They have no need more than the commonly recognized strength capacities of forgings. There are no common forgings.

Forgings of Alcoa Aluminum Alloy for aircraft uses are made from carefully prepared stock, controlled to provide maximum uniformity of metal structure. The dies in which the stock is worked are painstakingly designed with regard

to the service loadings indicated by the designer. To make the forging develop its greatest strength in the direction of greatest stress, care is taken so that the metal flows, as it is hammered or pressed, in this parallel to the direction of stress.

Although test specimens and the actual forgings show an extremely close correlation, X-ray examination and bend-down tests are sometimes applied as double assurance of soundness. The middle picture at right shows an Alcoa Aluminum forging successfully passing such tests.

Unassuming though these forgings are, all that is said here about them is commonplace to the men who make aircraft. That even commonplace tells volumes. For it is accepted as axiomatic that Alcoa Aluminum Alloy is produced to meet the requirements of aircraft construction. As always, Alcoa Aluminum is 2102 Gulf Building, Pittsburgh, Pennsylvania.



Bend-down test on Aluminum forging.

ALCOA ALUMINUM



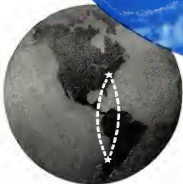
AVIATION
July 1933



THE *Army's*
BOEING XB15 BOMBER



Eclipse-Equipped
in thorough-going fashion



SANTIAGO, CHILE and RETURN — the recent magnificent performance of the XB 15 and her service personnel — attests the soundness of design, the excellent choice of equipment and the admirable technical skill of officers and crew.

ANOTHER splendid contribution of Boeing to the nation's defense, the great 4-engined XB 15 Bomber is a combat weapon and an engineering achievement in which the whole aircraft industry takes justifiable pride. To the degree that Eclipse Equipment enhances the plane's efficiency, we are genuinely proud to have helped. Eclipse auxiliary power plants, in dual installation, provide alternating and direct current for all the electrical needs of the airplane — radio, landing gear actuation, tail wheel, bomb hoist, air pump, hydraulic pump, de-icer distribution, as well as cooking facilities and other functions requiring electricity.

ECLIPSE AVIATION
DIVISION OF BENDIX AVIATION CORPORATION
BENDIX, NEW JERSEY